THE LOWER CARBONIFEROUS CORALS OF AUSTRALIA AND RELATED PROBLEMS

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This thesis is divided into three parts, the last two dealing with problems which arose during the course of the work necessary for the first. Part I describes the Lower Carboniferous Corals of Australia, and takes notice of stratigraphical and general considerations arising therefrom. Part II describes the type specimens of the genera *Clisiophyllum*, *Dibunophyllum*, and *Carcinophyllum*. Part III describes some of the various types of septal structures met with in the Palaeozoic Rugose corals, and endeavours to understand their significance, philosophical and structural.

I wish to record my thanks to the Senate of the University of Queensland for the award of the Scholarships which made the work possible, and to acknowledge my gratitude for the assistance given me by discussions with Miss G.L. Elles, Dr S. Smith, Dr W.D. Lang, Dr H.D. Thomas, Mr A.G. Brighton, Dr F.W. Whitehouse.

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I. The Lower Carboniferous Corals of Australia.

II. Type Specimens of the Genera *Carcinophyllum*, *Clisiophyllum*, and *Dibunophyllum*.

III. A Preliminary Review of the Structure of the Septa of Rugose Corals.

PART I

This paper revises, where possible, those species of Australian Lower Carboniferous corals already erected, and describes several new species collected by the author. It deals with the "Naos" modification of septa in these and other Rugose corals; and describes skeletal malformation in an Australian Viséan coral. It also gives a brief summary of our present knowledge of the Lower Carboniferous stratigraphy of Australia, and ends with a discussion on the variability of Rugose Coral Species.

Part I

CONTENTS

SYMPLECTOPHYLLUM nov.

Genotype, (Plates 1-5): Symplectophyllum[1] mutatum nov.; Upper Viséan, Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubera , Queensland.

Diagnosis: Simple Rugose corals with a very variable axial structure involving septa and tabulae. The septa are dilated in their early stage but later the median part may become cavernous, and the peripheral breaks down into horizontal tissue and consists of long narrow convex plates connected by granules of stereome. The tabulae, although sometimes complete, are usually incomplete. The dissepiments are small, and rather elongated, but do not enter the periphery of the coral. Stereome is irregularly developed.

Remarks: The genus is interesting for two reasons; first, it shows a type of septal modification like that seen in the Silurian genus Naos Lang (1926, p.428), and permits an explanation of such a structure; second, amongst the varying expressions of its axial structure it shows patterns reminiscent of those which Thomson (1883, pp.296-520) regarded as diagnostic for his Scottish Viséan genera Histiophyllum, Rhodophyllum, Aspidiophyllum, Dibunophyllum and Carcinophyllum.

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(1) Symplectos = woven.

<u>Symplectophyllum mutatum</u> sp. nov. (Plates 1-5).

<u>Holotype:</u> E 10, consisting of 8 slides and 4 pieces; in the Department of Geology, the University of Queensland. (Plate I, Figs 1-7)

<u>Diagnosis:</u> as for genus.

<u>Description:</u> External characters: Large simple corals usually with a long conicocylindrical adult stage, sometimes turbinate. The largest specimen (broken at both ends) was 13 cm. long with a maximum diameter of 3 cm. The average adult diameter is 2·5 cm. The epitheca is thick, with faint growth rings, and indistinct rugae. (N.P.) <u>Internal structures</u>: <u>Immature stage</u>: Transverse sections of immature stages were obtained from only four corals. These, illustrated in Pl.1, fig.7, Pl.1, fig.10, Pl.2, fig.8, and Pl.3, fig.7, show similarity in septal characters, diversity in the structure of the large axial area, and diversity in the amount of stereome present. The <u>septa</u> are dilated[1] and crowded. (Pl.3, fig.7 shows 24 of each order at a diameter of 7 mm.). The minor septa are from half to two thirds as long as the major, which usually attain a length of only one third the diameter of the corallite, since they are very seldom continuous with the septal lamellae in the axial structure. Septal dilation[2] always occurs; in one section (Pl.3, Fig.7),

(1) Seen microscopically, the septa are pinnately fibrous.
(2) Whilst the septa when examined by a lens appear well defined, and separate from the darker investing stereome which may fill the interseptal loculi, under the microscope they and the darker stereome are seen to merge into one another and their fibres are optically continuous.

it is so pronounced that the interseptal loculi are closed. Dissepiments are already present in these sections, although in Pl.3, Fig.7 they are entirely masked by the stereome dilating the septa. The axial area, whose diameter is about one third that of the corallite, may have its component plates entirely masked by stereome (Pl.3, Fig.7) diameter 7 mm.); it is known from transverse section only and may show sections of tabulae and dilated, discrete septal ends, variously arranged, with much (Pl.1, Fig.10, diameter 12 mm.) or little (Pl.1, Fig.7, diameter 12 mm.) stereome; or it may be occupied only by one or two semi-circular sections of tabulae about a dilated median axial lamella continuous with two opposite septa (Pl.2, Fig.8, diameter 6 mm.). The nature of the tabulae at these stages is unknown.

Adult stage: At a diameter of about 2 cm. the coral is mature. The septal characters are diagnostic, but the structure of the axial area whose diameter is 0·25 to 0·35 that of the corallite, is very variable.

The septa are crowded and dilated[1] with stereome. The major septa are usually discontinuous with the septal lamellae of the axial area, and the minor septa are 0·5 to 0·75 as long as the major. Axially, both orders of septa[2] are normal, and evenly

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(1) Whilst the septa when examined by a lens appear well defined, and separate from the darker investing stereome which may fill the interseptal loculi, under the microscope they their fibres the darker stereome are seen to merge into one another and and are optically continuous.

(2) Seen microscopically, the septa are pinnately fibrous.

thickened. Towards the middle of the length of the more dilated septa, there is a tendency for the irregular deposition of the septal stereome, and caverns of irregular outline are left in the septum (see Plate 4). When these are left along the plane of the septum, it appears split, and in such a cavern dissepiments may arise. Caverns on the sides of the septa may be infilled by interseptal stereome, darker in colour. Peripherally the dilated contiguous septa (which are essentially the vertical elements of the coral skeletom) break down into tissue with the character of horizontal skeletal elements (see Plate 5). In each septum this tissue consists of a large number of thin closely packed transverse plates, very long in the direction of elongation of the dissepiments; i.e. they have been deposited at successive levels of the peripheral calical floor. Some of them are axially continuous with dissepiments. These plates are thin and evenly arched upwards. They are sparsely and irregularly connected one to another by granules of stereome, which may sometimes unite to form short rods[1] piercing a few plates at right angles, see Pl.1, Fig.9. Since peripherally each septum was so dilated as to be in contact with its neighbours, the equivalent series of plates are also in contact. Some of the plates of a series are grouped, and these groups are continuous

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(1) These represent the vertical rods described in the Silurian Naos by W.D. Lang (1926).

with groups from the next series. Sometimes the relics of the median part of a septum are seen buttressing or even piercing the inner plates of a series, but usually a strong ring of dissepiments causes discontinuity in the septa between the two zones of septal modification. Rarely, at points of septal insertion, one short major and two short minor septa are developed in the place of one minor septum. All three correspond to only one peripheral series of transverse plates, so that this septal modification had occurred before septal insertion had been completed: (See septa at Point marked A, Plate 1, Fig.1).

Stereome is always present, varying in amount and position. Plates originating as vertical tissue, that is, the septa and the septal lamellae of the axial structure, are usually much dilated by the growth of all their pinnately arranged fibres into the interseptal loculi, so that the latter may become closed. In the case of horizontal tissue, i.e. dissepiments or tabulae, stereome may be deposited between the vertical elements (sometimes continuous with the fibres of the latter) on the upper surfaces (and only on the upper surfaces) of a series of dissepiments and tabulae representing all or part of a particular calical floor; and such deposition may be recurrent.

Dissepiments are numerous, small, rather elongate and steeply inclined; they do not occur between the septal modifications at the periphery but may be so strongly developed immediately within this peripheral zone as to cause the septa to be discontinuous.

The Tabulae form, with the septal lamellae, a variable axial structure. The septal lamellae, which are usually twisted and discontinouss with the septa proper, are variously developed; and on this variation depends the nature of the tabulae and the pattern of the axial structure. If the lamellae are few, they are usually irregular in course and discontinuous vertically; and the tabulae then tend to be complete and broadly domed. Axial structures reminiscent in transverse section of those Thomson considered diagnostic of Histiophyllum and Aspidiophyllum result. (See Pl.1, Figs.1-7, Pl.2, Figs.1-6). But the few lamellae may attain a rough dibunophylloid arrangement, and the tabulae are then more steeply domed and less complete (See Pl.3, Fig.6). When the lamellae are more numerous, they are usually strongly twisted and continuous vertically. The tabulae are then incomplete and the arrangement is rhodophylloid. Stereome is common in the axial structure (See Plate 3), and is usually developed when numerous lamellae are present, and the pattern is then carcinophylloid (see Pl.3, Figs.1-3). All these, and intermediate patterns may occur in the one individual (see Pl.1, Figs.2 and 5), but usually one type is predominant.

Remarks: The material used in this study consisted of 20 individuals all from the same locality and horizon, and from which over 100 slides and surfaces have been cut. The corals appear to have grown in place, and are encrusted by fine growths of calcareous algae. Owing to the massive unweathered nature of the fine grained grey limestone matrix, no individuals with tips were collected, and no photographs of external form could be made.

In this material variability occurs in the following:-

(1) Shape.

(2) Amount of stereome present.

(3) Pattern of the axial structure.

(4) Degree of development of caverns in the median parts of the septa.

(5[Degree of development of the peripheral modification of the septa with transverse tissue.

Variation in shape cannot be correlated with any other character. Gerth (1921) in his studies on the Permian corals of Timor, showed that these long thin forms were comparatively free from stereome, while the short stout forms were very stereoplasmid; but in these Queensland Viséan corals there is no such connection.

Variability in the amount of stereome present is most striking in this species, and all other variations, except that in shape, appear to be in some degrees dependent on it. The young corallite is always practically filled with it, but becomes less stereoplasmid with growth. After such a disappearance stereome may again be deposited at one or more horizons, varying in amount and position. Such corals form a distinctive group, (See Plate 3). The holotype is not very stereoplasmid, but F 2511 is a typical example. This discontinuous deposition cannot be correlated with any change in diameter of the coral, such as might be expected were it a rejuvenescence character.

Variability in the pattern of the axial structure is extreme, as described above. A consideration of all slides and surfaces shows that there is no progressive transition from one type to another; such changes as occur do so suddenly, and with the possibility of reversion.

The development of caverns in the median parts of the septa can only be seen if the septa concerned were dilated.

Peripheral dilation of the septa seems to be necessary before the peripheral series of transverse plates can be developed in the septa; but when stereome has dwindled from the corallite, these series can still be seen developed to the width of the earlier dilated septa; their derivation from the vertical elements is not then obvious, and they look like modifications of dissepimental tissue, (See Plate 2, Fig.1).

PLATE I

Symplectophyllum mutatum nov; from the upper Visean limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below, and the specimens from which they are cut, are in the University of Queensland collection.

All figures magnified 2 diameters.

Fig.1:- Section, not perfectly transverse, from the holotype E 10. (upper surface of Fig.2).

Fig.2:- Vertical section from ditto. This, with Fig.5 shows the diversity of axial structure to be found in one less stereoplasmid individual.

Figs.3:- and 4. Transverse sections from ditto, showing very open axial structure.

Fig.5:- Vertical section from ditto. See Fig.2.

Figs.6:- and 7. Transverse sections from ditto.

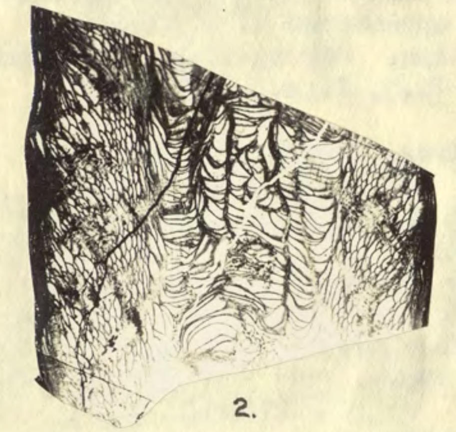
Fig.8:- Transverse section from E 6, showing twisted axial lamellae.

Fig.9:- Vertical section from ditto, showing highly arched tabulae, compare with the lower part of Fig.2; showing also rods reminiscent of the 'vertical pillars' of Naos Lang.

Fig.10:- Transverse section from early stage of ditto, showing stereoplasmid nature.

PLATE I


1.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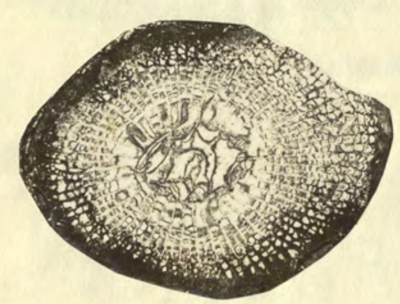
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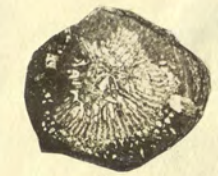

10.

PLATE 2

Symplectophyllum mutatum nov. from the Upper Viséan limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below, and the specimens from which they are cut, are in the University of Queensland collection.

All figures magnified 2 diameters.

Fig.1:- Transverse section from F 2385 (upper surface of Fig.2). The appearance of a fossula is due to malformation. For sections along lines AB, CD, EF, see Pl.5, Figs.5,6, & 7.

Fig.2:- Vertical section from ditto.

Fig.3:- Transverse section from F 2454; showing very open axial structure.

Fig.4:- Vertical section from ditto; showing complete, slightly domed tabulae. For enlargement of inset see Pl.5, Fig.9.

Fig.5:- Transverse section from E 1, showing the structure of the septa and a non-stereoplasmid twisted axial structure. For enlargement of inset, see Pl.5, Fig.1.

Fig.6:- Transverse section from E.N. with loose axial structure.

Fig.7:- Transverse section from F 2451, with axial structure reminiscent of Dibunophyllum, Thomson and Nicholson.

Fig.8:- Transverse section from early stage of E 4, showing median axial lamella.

Figs.9, 10, 11 & 12.:- Serial transverse sections from E.4.

PLATE 2

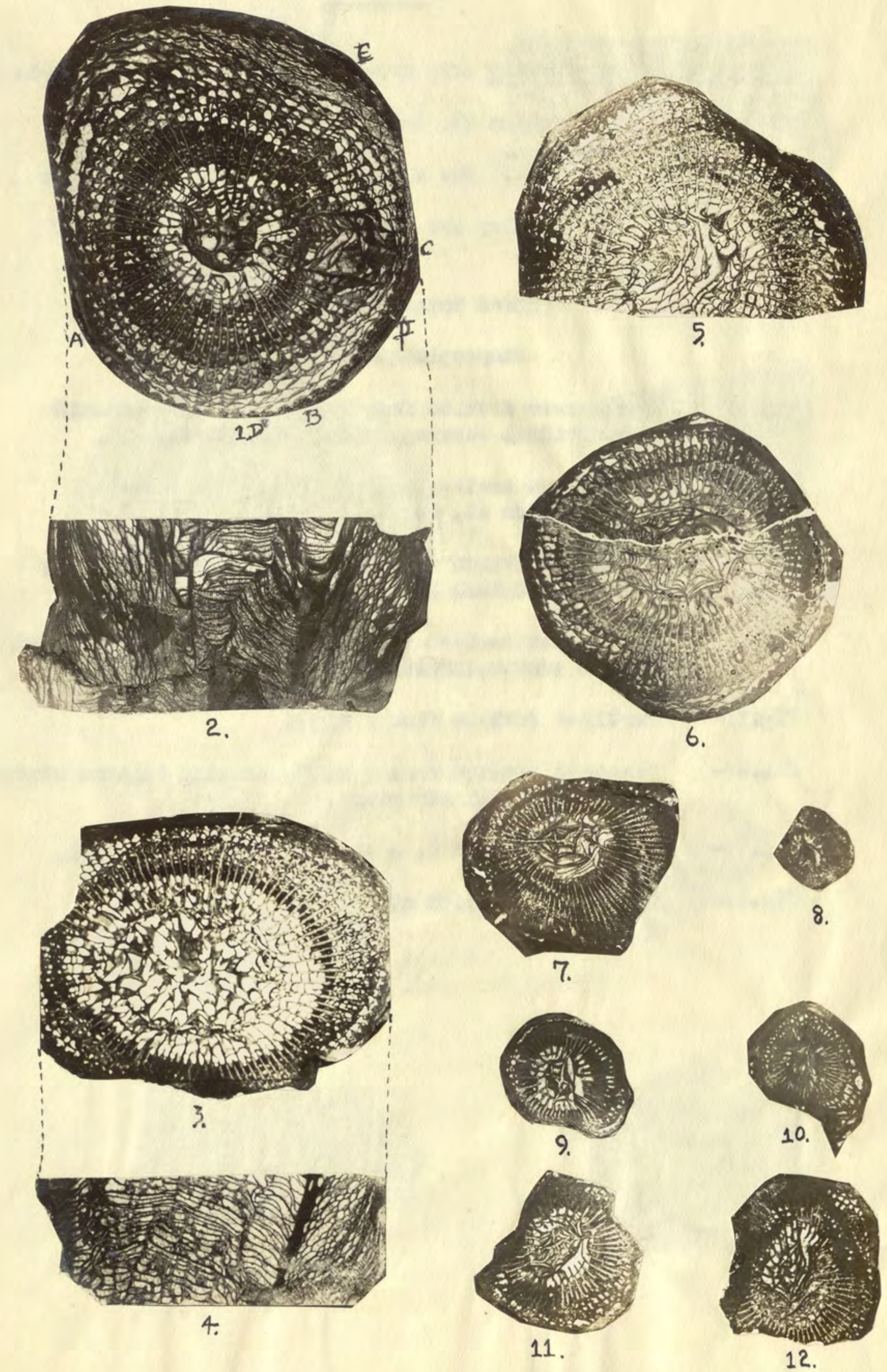


PLATE 3

Symplectophyllum mutatum nov; from the Upper Viséan limestones of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collection.

All figures magnified 2 diameters.

Stereoplasmid individuals.

Fig.1:- Transverse section from F 2512; a stereoplasmid individual showing septal structures.

Fig.2:- Transverse section from F 2511. For section along line AB, see Pl.5, Fig.4.

Fig.3:- Vertical section from ditto, showing variability of stereoplasm in the axial structure.

Fig.4:- Transverse section from young stage of ditto, with open stereoplasmid axial structure.

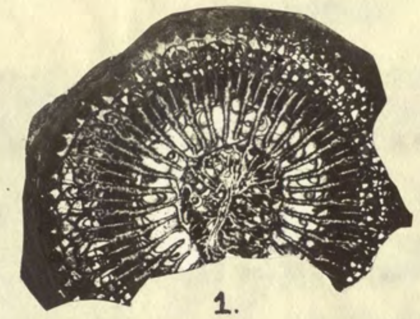
Fig.5:- Vertical section from F 2499.

Fig.6:- Diagonal section from F 2489, showing twisted stereoplasmid axial structure.

Fig.7:- Young stage of E 8, a stereoplasmid individual.

Fig.8:- Transverse section of F 2514.

PLATE 3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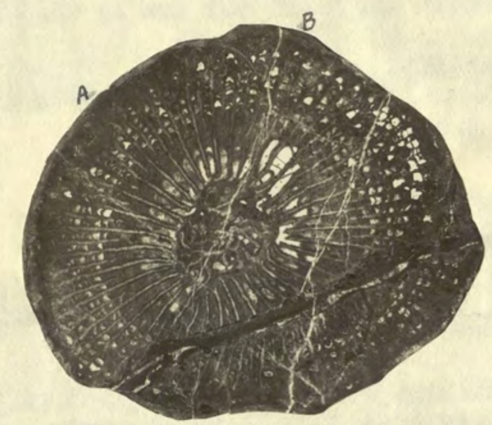
5.



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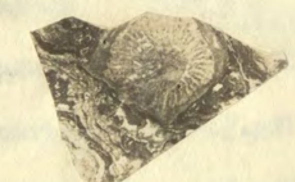
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4.


8.

PLATE 4

Illustrating the cavernous structure of the median parts of the septa of <u>Symplectophyllum mutatum</u> nov.; from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collection.

Figs. 1, 2 & 3 x 10 diameters.

Figs. 4, 5 & 6 x 2 diameters.

Fig.1:- An enlargement of inset in Fig.4, showing details of septal structure in transverse section.

Fig.2:- An enlargement of inset in Fig.5, showing details of cavernous septal structure in transverse section.

Fig.3:- An enlargement of inset in Fig.6, showing details of cavernous septal structure in vertical tangential section.

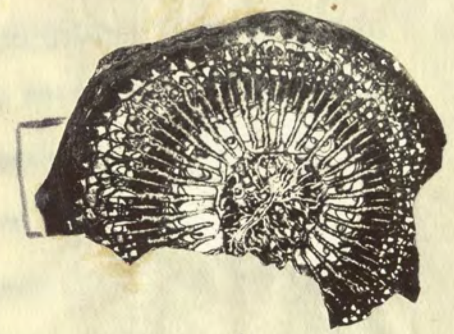
Fig.4:- Transverse section from F 2512. See Fig.1.

Fig.5:- Transverse section from F 2489. See Figs.2 & 3. and Pl.5, Fig.3.

Fig.6:- Tangential section through line AB in Fig.5. See Fig.3.

PLATE 4

1.



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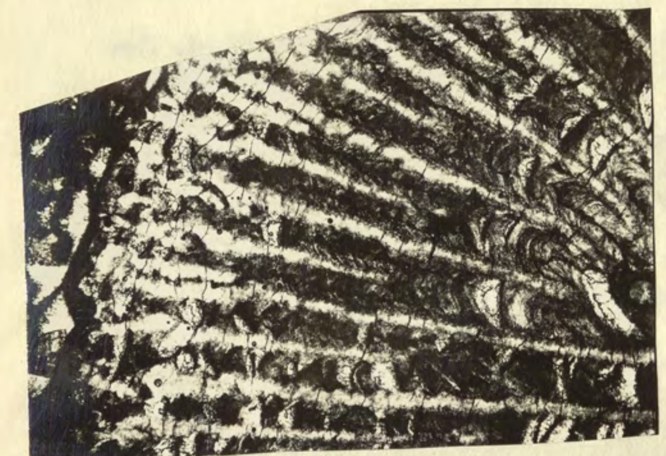

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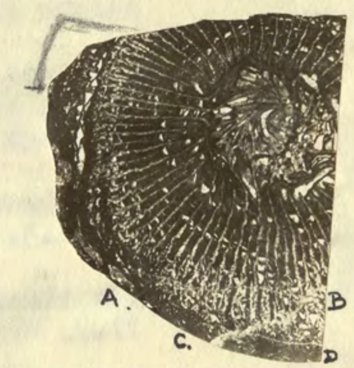

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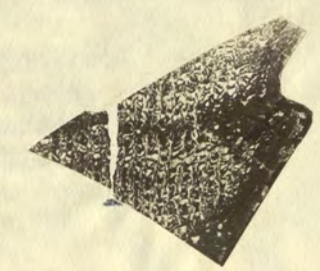


6.

PLATE 5 (Compare Plates 14-16)

Illustrating the peripheral modifications into horizontal tissue of Symplectophyllum mutatum nov.; from the Upper Viséan limestone of Latza's Farm in Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collections.

Fig.1:- Horizontal tissue replacing the peripheral parts of the septa seen in transverse section. Enlarged from inset in Pl.2, Fig.5. x 10 diameters.

Fig.2:- Ditto seen in peripheral tangential section. Enlarged from inset of Fig.3. x 10 diameters.

Fig.3:- Peripheral tangential section through the peripheral modifications of the septa in F 2489; (through line CD in Pl.4, Fig.5) x 2.

Fig.4:- Ditto through ditto in F 2511 (through line AB in Pl.3, Fig.2). x 2.

Fig.5:- Ditto through ditto in F 2385 along line AB in Pl.2, Fig1. x 2.

Fig.6:- Tangential section through ditto in ditto along line CD in ditto. x 2.

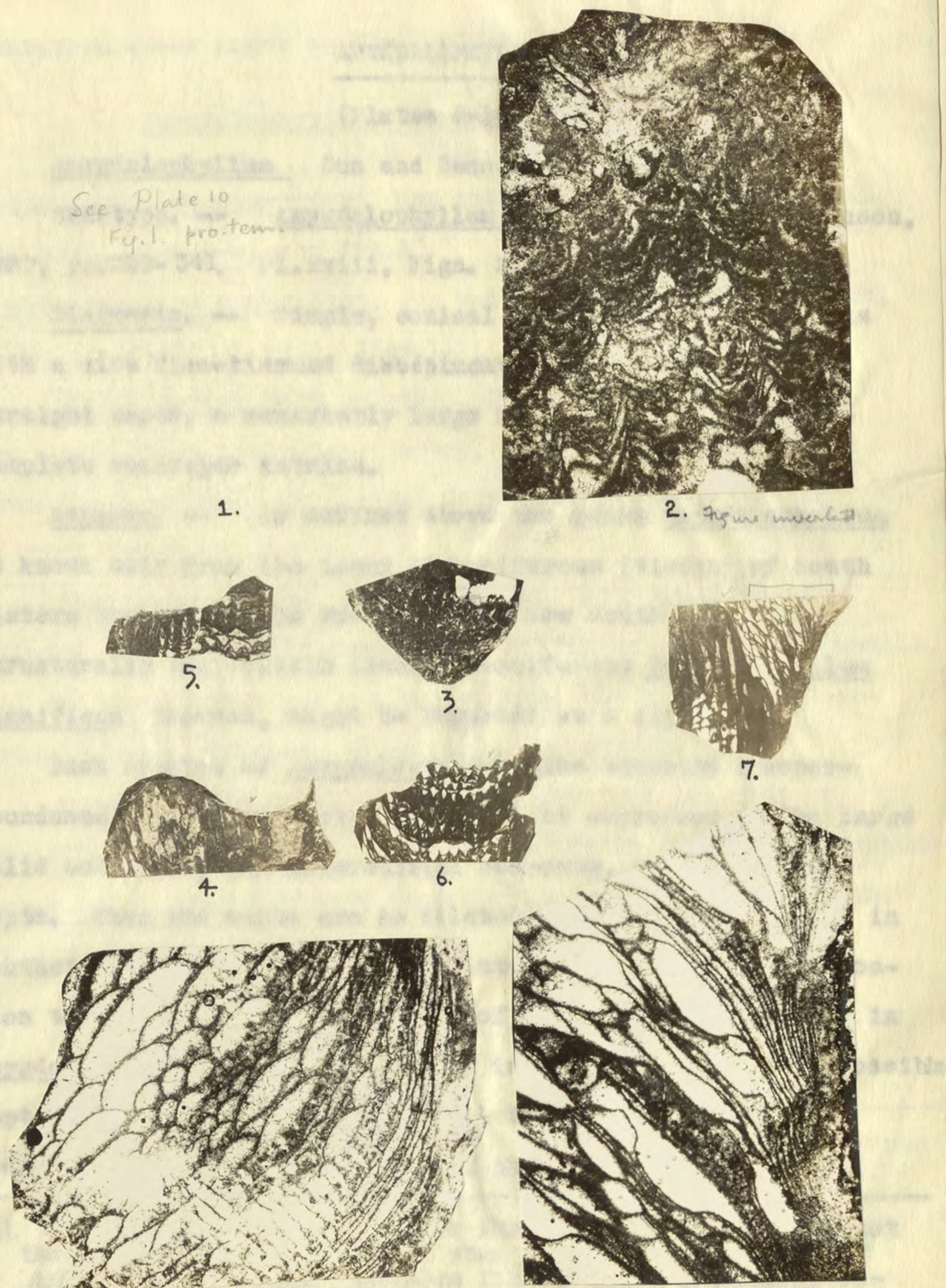
Fig.7:- Ditto through ditto in ditto along line EF in ditto. x 2.

Fig.8:- Inset in Fig.7 enlarged. x 10.

Fig.9:- Vertical section of F 2545, showing the peripheral modification of the septa in vertical sections, and structures (A) similar to the vertical pillars of Neos Lang. An enlargement of inset of Pl.2, Fig.4. x 10.

PLATE 5

See Plate 10 Fig.1. pro tem.



AMYGDALOPHYLLUM

(Plates 6-10).

Amygdalophyllum Dun and Benson, 1920, pp.339-341.

Genotype. — Amygdalophyllum etheridgei Dun and Benson, 1920, pp.339- 341, Pl.xviii, Figs. 2-6 non Fig.1[1].

Diagnosis. — Simple, conical or cornute Rugose corals with a wide fine-tissued dissepimental area, numerous long straight septa, a remarkably large solid columella, and incomplete vesicular tabulae.

Remarks. — As defined above the genus Amygdalophyllum is known only from the Lower Carboniferous (Viséan) of South Eastern Queensland and North Eastern New South Wales; but structurally the British Lower Carboniferous Koninckophyllum magnificum Thomson, might be regarded as a diphymorph.

Each species of Amygdalophyllum has secreted a superabundance of calcium carbonate. This is expressed in the large solid columella, the interstitial stereome, and the dilated septa. When the septa are so dilated peripherally as to be in contact, they sometimes show the interesting type of modification to horizontal tissue typical of Symplectophyllum. But in Amygdalophyllum this modification is not seen in all the possible septa of one individual, nor in all the individuals of one species, nor in all the species of the genus. The genus

(1) Benson and Smith (1923) in a footnote p.161, observe that the original of Fig.1 proved when cut to be a specimen of Zaphrentis sumphuens Etheridge fils., which externally ~~externally~~ resembles A.etheridgei.

therefore sheds light on how a trend may be expressed.

Amygdalophyllum etheridgei, Dun and Benson.
(Pl.6, Figs. 1-2).

Amygdalophyllum etheridgei Dun and Benson, 1920, pp.339-341; Pl.xviii, Figs.2-6, non Fig.1[1].

Amygdalophyllum etheridgei, Dun and Benson; Benson and Smith, 1923, pp.161-5; Pl.viii, Figs.1-3; Pl.ix, Fig.2.

Type Material with Holotype, in the collection of the New South Wales Geological Survey, Sydney; sections R 22072 from the holotype, and R 21947 from type material, in the British Museum.

Diagnosis: Large Amygdalophyllum with very numerous dilated septa; the major septa are confluent with the columella, and the minor septa are unusually long; the columella is extremely large, fibrous, elliptical, and cuspidate.

Remarks: The species is known only from the original locality, in mudstones of the Burindi Series (Visean) at Babbinboon, N.S.W. For adequate description, see Benson and Smith, 1923, pp.161-5, Pl.viii, Figs.1-3; Pl.ix, Fig.2.

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(1) Benson and Smith (1923) in a footnote p.161, observe that the original of Fig.1 proved when cut to be a specimen of Zaphrentis sumphuens Etheridge fils., which externally resembles A.etheridgei.

Amygdalophyllum inopinatum.

(Pl.6, Figs. 3-8, Pl.7, Figs. 1-3).

Koninckophyllum inopinatum Etheridge fils., 1900, pp.20-21, Pl.i, Fig.2, Pl.ii, Figs. 9-10.

Koninckophyllum inopinatum Etheridge fils.; Benson and Smith, 1923, p.161.

Type Material from the Upper Viséan Limestone of Lion Creek, Stanwell, near Rockhampton, Queensland, is preserved in the collection of the Geological Survey of Queensland, Brisbane.

Diagnosis: Large Amygdalophyllum with very numerous septa; major septa reaching almost to the columella, but never confluent with it:, minor septa half as long as major; columella lenticular cuspidate, narrower than in A.etheridgei.

Description: The corallum is robust, conical or turbinate, straight, sometimes with a slightly curved and flattened or spreading base of attachment (See Pl.6, Fig.8). Average dimensions of type material: height 3·5 cm., diameter 3 cm.; of Riverleigh material, height 4 cm., diameter 3 cm., with a largest individual, incomplete, 7 cm. in height, and 4·5 cm. in maximum diameter. Calice with a round everted margin, probably shallow. Epitheca thin, annulate.

The septa are very numerous and vary in number in the different individuals. The type material shows a variation between 42 and 99 septa of each order, and the Riverleigh material between 52 and 64. In the Riverleigh material the septa also vary in strength of development, for instance, they may be dilated in the tabulate area (See Pl.6, Fig.3). The major septa are straight except that their axial angles may be turned aside, and extend almost to the columella, being seldom if ever confluent with it. In specimen E Z from Riverleigh, this incipient diphyphylloid trend[1] has progressed to further withdrawal of the septa, and discontinuity in the columella. The minor septa are seldom more than half the length of the major, and are thinner. Indeed in F 2391 from Riverleigh, in which the septa are very tenuous, the minor septa occasionally disappear, leaving the dissepiments between the major septa arranged in an irregular herring-bone pattern (See Pl.7, Fig.2). This specimen shows a weak development of the <u>Naos</u> trend[2]; in that the septa and dissepiments in parts of the periphery are replaced by continuous series of <u>Naos</u> like horizontal tissue, closely placed, but loose and without connecting granules of stereome (See Pl.7, Fig.2). Discontinuity in the minor septa, sometimes also in the major septa, of some Riverleigh specimens is complementary to the development of large dissepiments on which the septa are represented as crests.

The dissepiments are small, rather elongate, steeply inclined, and copiously developed with a tendency to anastomose;

(1) The diphyphylloid trend is one leading to the abolition of a columella, the withdrawal of the septa from the axis, and the flattening of the tabulae.

(2) See footnote page 18.

they form a zone whose radius is half that of the corallite. The tabulae are incomplete and domed, the tabellae being rather small, plentiful, convex upwards and outwards, but of irregular form near the dissepimental zone.

The columella is oval, stout, rod-like, non-cellular, and extending the entire length of the corallite in the type material; in the Riverleigh material it is usually less strongly developed, and may be either oval, elliptical, cellular, or plate like.

Distribution: The species is known only in South Eastern Queensland, from the Upper Visean limestones. In addition to the type locality (supra) it also occurs at Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubera.

Remarks: Structurally this species might be regarded as A. etheridgei, in which an incipient expression of the diphyphylloid trend has resulted in the comparative withdrawal of both orders of septa from the axis, and in the weaker development of the columella. One must not disregard the possibility, however, that a very strongly columellate form such as A. etheridgei might have been derived from one less strongly columellate. For this and geographical reasons it is convenient to regard the two as separate species. Variability is pronounced, especially in the Riverleigh material, and occurs as seen above, in size, number of septa, and dilation of septa

(1) The Naos trend is here defined as a tendency for stereome-dilated septa to break down into horizontal tissue in the form of numerous fine convex plates transverse to each septum, the plates being connected by granules of stereome whose perfect arrangement is in rods normal to the plates. But for a full description of this trend and its expression see pp. 41-46.

Modifications are also to be seen due to the very weak, sporadic development of the diphyphylloid, lonsdaloid[1] and Naos trends.

<u>Amygdalophyllum conicum</u> sp.nov.

(Plates 8, 9, and 10).

<u>Holotype</u>: A slide on which are mounted 8 sections of specimen E 36, preserved in the Department of Geology, the University of Queensland, Brisbane (Pl.8, Figs.2-9).

<u>Syntypes</u>: F 2445 (4 slides and 1 piece) (Pl.9, Figs.5-8) shows the maximum development of trend(1)(<u>vide infra</u>.)F(c) (8 slides)(Pl.9, Figs.9-16) shows the maximum development of trend (2) vide infra., while F(2437),(4 slides with 10 serial sections, and 1 piece)(Pl.8, Figs.10-19) shows the same of Trend (3)(<u>vide infra.</u>) All types are preserved in the Department of Geology, the University of Queensland, and all are from the Upper Viséan limestone on Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubera , Queensland.

<u>Diagnosis</u>: Short, straight, conical <u>Amygdalophyllum</u> with deep conical calyx. Before the appearance of dissepiments, the major septa are straight, confluent with the small columella, and slightly and evenly dilated. The adult appearance is

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(1) The lonsdaloid trend is one in which the septa withdraw from the periphery.

variable due to the differential expression of three common trends (1) Septal dilation, chiefly peripheral, with (2) peripheral modification of these dilated septa to horizontal tissue, and (3) withdrawal of the septa from the periphery.

Description: External characters: The corallum is a straight cone (See Pl.8, Fig.1); the adult individuals show great constancy in size - height about 4 cm., and diameter about 2 cm.; the conical calyx is from 1 to 2 cm. deep. When the septa are dilated or modified to transverse tissue, they form flat stripes on the calical floor, widening towards the periphery. Otherwise they rise from the floor as thin bars. Epitheca faitly rugose, thick, and irregularly annulate.

Internal structures: In the youngest stage observed, diameter 2 mm., the septa are arranged pinnately, coalescing at the centre; the cardinal fossula is very large, and the transverse tissue is represented by simple tabulae only (See Pl.9, Fig.9). This pinnate stage has been called, in other corals, the zaphrentoid. With the appearance of rudimentary minor septa, the pinnate symmetry gives place to radial, and the well developed major septa coalesce axially with a columella. The minor septa then lengthen, and dissepimental tissue arises. This is the last stage in which all the individuals are identical.

In the fully mature corals, some characters are common to all individuals, but there is variation due to the sporadic expression of three common trends.

Common characters are these: There are about 30 septa of each order, the minor septa being about half the length of the major, which show a tendency to withdraw from contact with the columella (Pl.8, Figs.4-9). The columella is continuous vertically, and well developed, lenticular or elliptical in section. The tabulae are incomplete; and slope up towards the columella, the tabular tissue consisting of vesicles of varying size, convex upwards and outwards, those abutting on to the columella being larger. When the septa are withdrawn from the columella, the inner tabular vesicles tend to become flat.

Superimposed on these common characters are the modifications due to the sporadic expression of three trends. The first of these is the dilation of the septa; this may be peripheral so that the septa are in contact there (Pl.9, Figs.5-8), or in the tabulate area (Pl.9, Figs.2,4). The second, the Naos trend, is expressed by the modification of some of the dilated septa which are in contact peripherally with horizontal tissue. In each septum this consists of numbers of fine convex transverse plates connected by granules of stereome or vertical relics of the septa. The transverse plates of one septum may be continuous with those of the next (Pl.9, Figs.14-16). The third the lonsdaleoid trend, is expressed by the withdrawal first of the minor, and later of the major also, from the epitheca, the septa being represented as crests on the dissepiments (See Pl.8, Figs.10-12; Pl.9, Fig.2; 4, 8, 14, and 15). These three trends may be expressed in different degrees in the same individual.

Remarks: The 66 slides from 22 specimens, all from the same locality and horizon, form a very complete and very convincing example of the extreme variability of individuals of one species due to the differential expression of common trends.

Amygdalophyllum sp. near conicum
(Plate 10).

Specimen F 2449 (2 slides and 4 pieces) in the Department of Geology, the University of Queensland from the Upper Visean limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland, possibly represents a forma of Amygdalophyllum conicum, which is abundant at the same locality and horizon.

Description: External characters. The specimen consists of a large hystero corallite or rejuvenescence bud arising centrally from a broken mature calyx, the diameter of the bud at origin being 15 mm., while that of the parent is 25 mm. The bud continues for 4 cm., where it is broken across. It is then of oval section, the longer diameter being 25 mm., and the smaller 20 mm. The bud of this individual is thus larger than the average mature individual of <u>A. conicum</u>. The epitheca is thin and probably discontinuous.

Internal structures: The septa are of two orders, 30 in each cycle. The major septa are usually in contact with the columella, and the minor septa are half their length. Both orders are dilated to the shape of a wedge, and in contact peripherally. The <u>Naos</u> trend is strongly developed for where the septa are in contact they often become modified into horizontal tissue consisting of numbers of thin convex plates as wide as the septum, in contact or continuous with others from the neighbouring septum. In each septum these plates are connected by granules of stereome, irregular in position or in series forming rods normal to the plates, or by vertical relics of the septum. Not all the dilated septa are so modified. In vertical section these transverse modifications are seen to be continuous axially with dissepiments. Dissepiments are developed between major and minor septa where these are not in contact. They are of moderate size, very elongate, and the steepness of their inclination increases with their distance from the periphery. They may become so large and strongly developed that the septa (whether modified or not) become discontinuous. The tabulae are incomplete, vesicular; the vesicles immediately about the columella tend to be flattened and larger than the rest, which are irregular in size and inclination. Most of the vesicles seem crushed or broken. The columella is very irregular in outline, and of variable strength of development, usually small.

<u>Remarks:</u> This corallite differs from typical <u>A. conicum</u> only in its rejuvenescence, its larger size and the stronger development of the Naos trend.

<u>Amygdalophyllum vallum</u> sp.nov.

(Pl.7, Figs. 4-7).

<u>Holotype:</u> E 30 (4 slides and 2 pieces), from the Upper Visean limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland, in the collection of the Department of Geology, the University of Queensland.

<u>Diagnosis:</u> Short, widely turbinate <u>Amygdalophyllum</u> with regularly dilated amplexoid septa, fine regular dissepiments, wide tabulate area and strong oval fibrous columella.

Description: The Corallum is robust, straight and conical, height and diameter each about 20 mm. The epitheca is thin and annulate. The septa are of two orders, straight and regularly dilated so that they are approximately equal in width to the interseptal loculi, slightly tapering axially. The major septa are amplexoid, extending little over halfway towards the axis; the minor septa are about half this length. The dissepiments are very small, regularly arranged in thin concentric rings, steeply inclined. The tabulae are of two series of equal radius; the inner series consists of large plates only slightly inclined upwards and outwards over most of their course; but at the columella they arch vertically and take part in its construction, and at their peripheral edges they bend sharply downwards; they may occasionally reach the dissepiments, but usually the small, more highly arched outer tabellae separate them from the dissepiments. The columella is widely oval, solid, an independent rod not buttressed by axial septal ends, formed by the coalescence of the up-arched edges of the inner tabellae.

Remarks: The interest of this species lies in the septa being amplexoid[1] while the columella remains very strongly developed; and in the columella being formed by the up-arched axial edges of the inner tabellae. The amplexoid trend is obviously not due to the lack of available stereome.

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(1) i.e. withdrawn axially.

PLATE 6

Amygdalophyllum Dun and Benson.

All figures x 2 diameters.

Fig.1:- A. etheridgei Dun and Benson. Reproduction of a transverse section figured by Benson and Smith 1923, Pl.viii, Fig.1. Burindi Series, Babbinboon, N.S.W.

Fig.2:- A. etheridgei Dun and Benson. Reproduction of a vertical section, figured by Benson and Smith 1923, Pl.viii, Fig.1. Burindi Series, Babbinboon, N.S.W.

Fig.3:- A. inopinatum (Etheridge) Transverse section of E. 24 in the University of Queensland Collection from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland; showing septal detail in younger adult stage.

Fig.4:- Vertical section of ditto. (Fig.3 is from lower surface, and Fig.5 from upper surface).

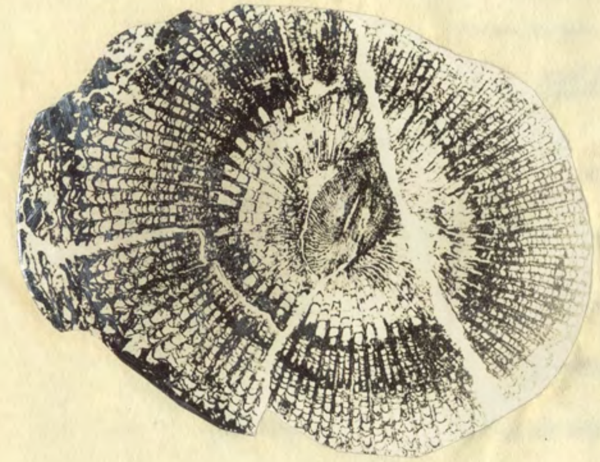
Fig.5:- Transverse section of ditto.

Fig.6:- A. inopinatum (Etheridge) Transverse section of F 2384 in the same collection from the same horizon and locality.

Fig.7:- A. inopinatum (Etheridge) Transverse section of F 2346 in the same collection from the same horizon and locality.

Fig.8:- Vertical section of ditto showing basal outgrowth for attachment.

PLATE 6



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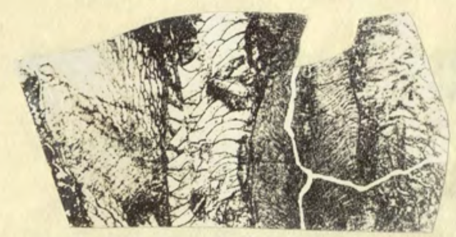

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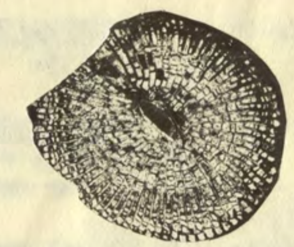

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PLATE 7

Amygdalophyllum Dun and Benson.

All the sections figured below and the sections from which they are cut, are in the University of Queensland Collection, from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

All figures magnified 2 diameters.

Fig.1:- *A. inopinatum* Etheridge. Transverse section from F 2493.

Fig.2:- *A. inopinatum* Etheridge. Transverse section from F 2491, showing peripheral *Naos* modifications of the septa.

Fig.3:- Vertical section of ditto.

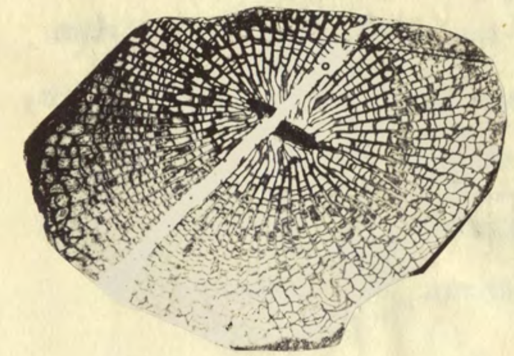
Fig.4:- *A. vallum* nov. Transverse section from the holotype, E 30.

Fig.5:- Vertical section from ditto.

Fig.6:- Transverse section from ditto, younger stage.

Fig.7:- *A. vallum* nov. Transverse sections from F 2453.

PLATE 7



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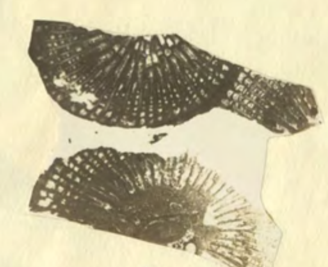


7.

PLATE 8

<u>Amygdalophyllum conicum</u> nov., from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland; the sections figured below and the specimens from which they are cut are in the University of Queensland collection, Brisbane.

All figures magnified 2 diameters.

Fig.1:- <u>A. conicum</u> nov., external appearance.

Figs.2-9. :- <u>A.conicum</u> nov., Serial transverse sections of the holotype E 30.

Figs.10-19:- <u>A. conicum</u> nov. Serial transverse sections of syntype F 2437 showing discontinuous septa.

PLATE 8

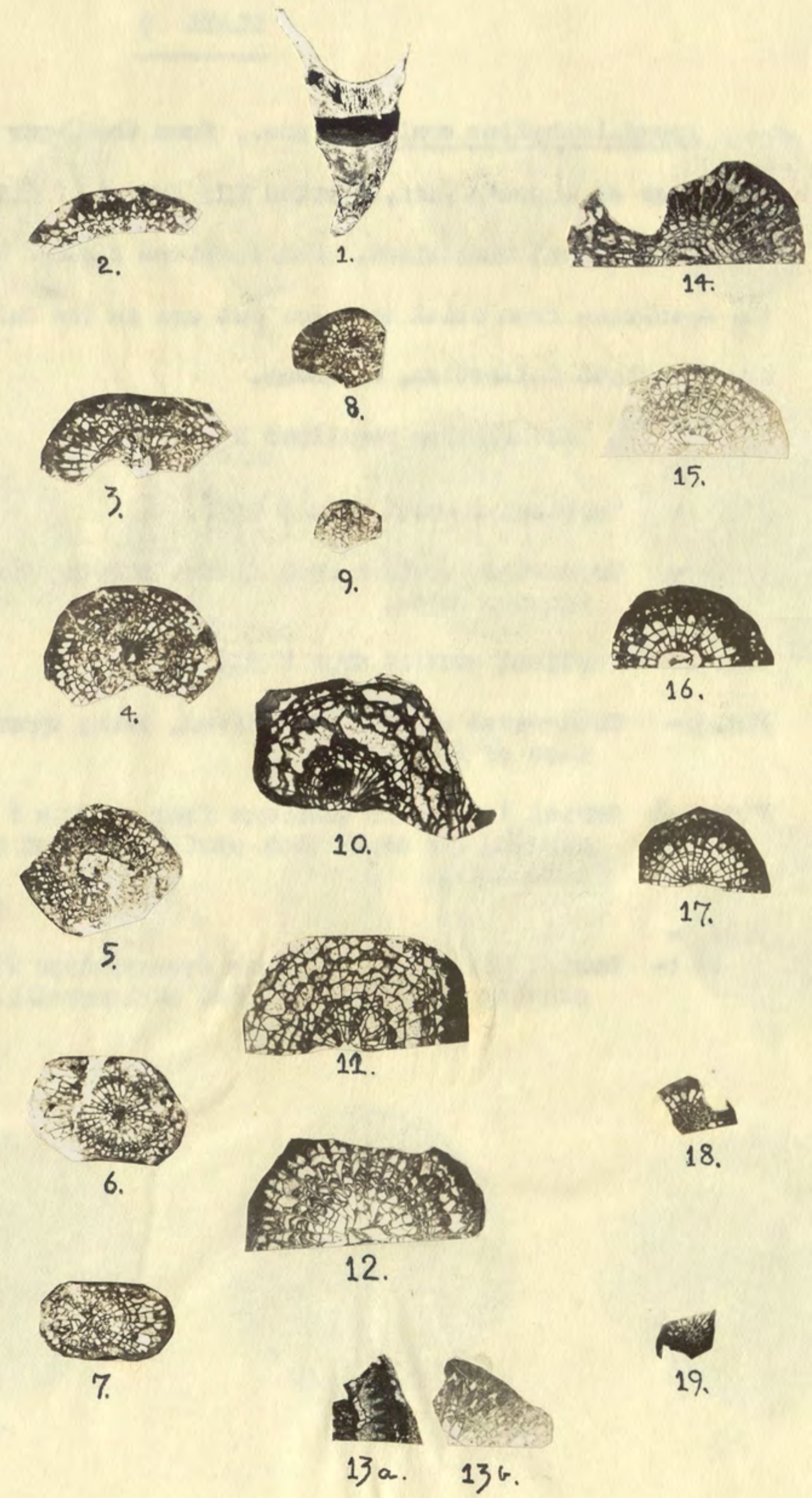


PLATE 9

Amygdalophyllum conicum nov., from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collection, Brisbane.

All figures magnified 2 diameters.

Fig.1:- Vertical section from F 2498.

Fig.2:- Transverse section from ditto, showing discontinuous septa.

Fig.3:- Vertical section from F 2436.

Fig.4:- Transverse section from ditto, being upper surface of Fig.3.

Figs.5-8: Serial transverse sections from syntype F 2445 showing the septa with peripheral zone of thickening.

Figs.9-16 :- Serial transverse sections from syntype F(c) showing the septa modified peripherally.

PLATE 9

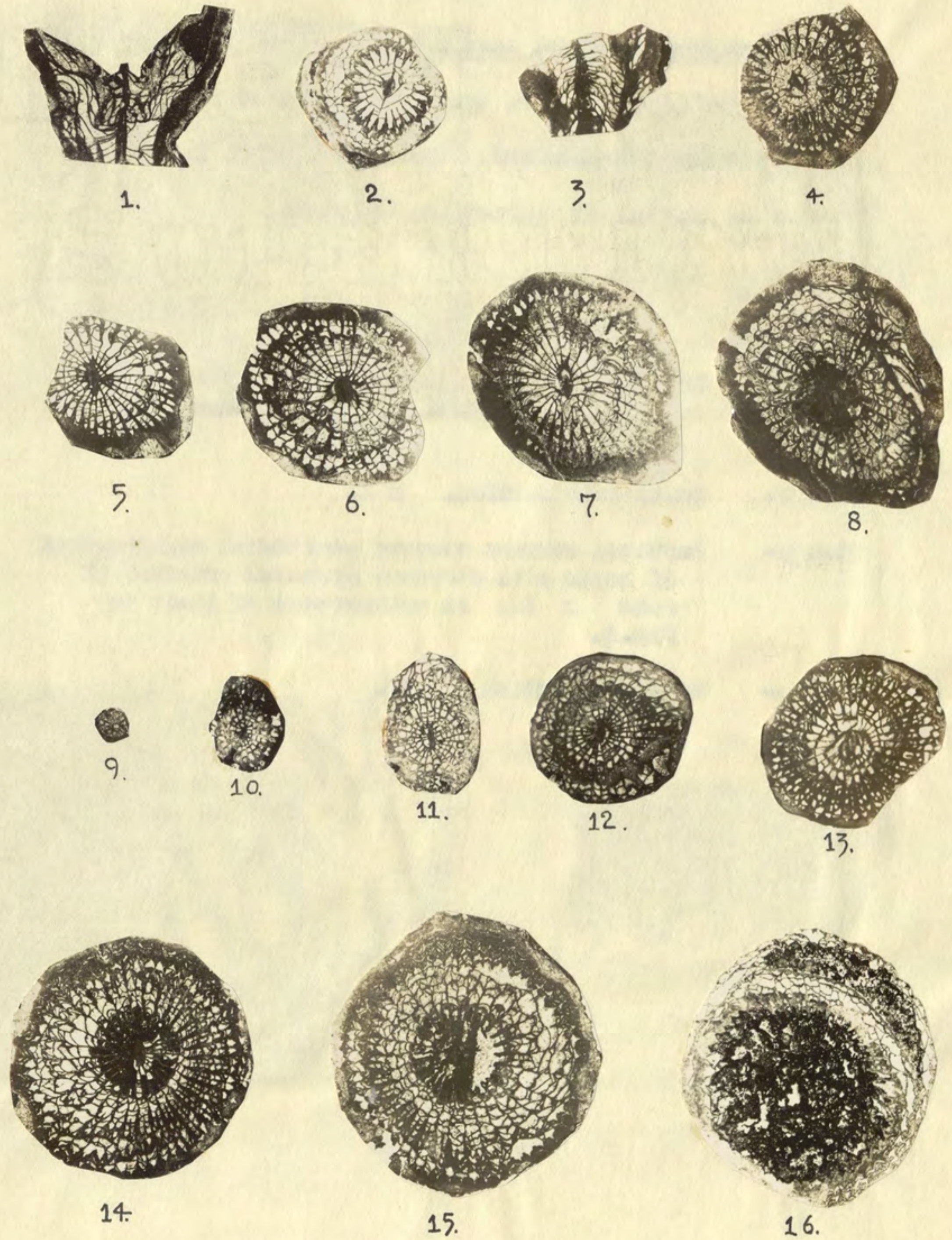


PLATE 10

Amygdalophyllum sp. near conicum from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. Specimen F 2449, in the University of Queensland Collection, Brisbane.

Fig.1:- Transverse section showing peripheral modification of septa x 10. An enlargement of inset in Fig.2.

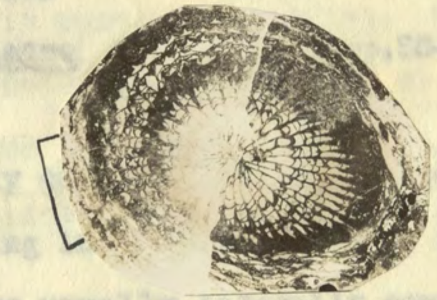
Fig.2:- Transverse section. x 2.

Fig.3:- Vertical section showing peripheral modification of septa with stereome granules arranged in rods x 10. An enlargement of inset in Fig.4.

Fig.4:- Vertical section x 2.

PLATE 10

1.



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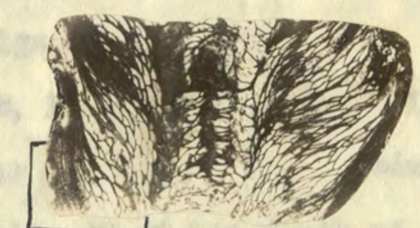


4.

APHROPHYLLUM.

(Plates 11-13).

Aphrophyllum Smith, 1920, pp.53-55.

Genotype: Aphrophyllum hallense Smith 1920, pp.53-55, Pl.II, Figs.1-5.

Diagnosis: Large imperfectly contiguous rugose corals, either of massive habit, or growing in clumps which may not be true colonies. The corallites are usually laterally compressed. The major septa are long, turned aside axially, and reach or nearly reach the axis. The minor septa are half this length. Except in young stages, a wide development of horizontal tissue separates the septa from the periphery. The tabulae are broadly domed, and incomplete.

Aphrophyllum hallense Smith

(Plate 11, Figs. 1-3).

Aphrophyllum hallense Smith, 1920, pp.53-55, Pl.II, Figs.1-5.

Holotype: B 8 from the Lower Carboniferous (Viséan) Burindi Series of the Parish of Hall, 16 miles south of Bingara, New South Wales, preserved in the Australian Museum, Sydney. Duplicates (R have been placed in the British Museum, and part of the holotype is in the Sedgwick Museum, Cambridge.

<u>Diagnosis</u>: Massive <u>Aphrophyllum</u>, corallites imperfectly contiguous, turbinate, with average diameter 15 mm. Septa not crowded. Peripheral zone of transverse tissue occupies up to one third the radius of the corallite.

<u>Description</u>: The corallum is compound, massive. The corallites are imperfectly contiguous, partly rounded or imperfectly polygonal, turbinate, and laterally compressed. The largest corallite had a diameter of 20 mm.; the average diameter is 15 mm. gemmation is lateral.

The septa rarely show a radial arrangement, since the corallites are laterally compressed. They are dilated and wedge shaped, varying in number between 20-32 of each order. The major septa reach or nearly reach the axis; their axial edges are turned aside or may be twisted together to form an axial structure. The minor septa are seldom more than half the length of the major. The dissepiments of the interseptal loculi are small, regular, and steeply inclined; but the horizontal tissue separating the septa from the epitheca is less steeply inclined, and consists usually of coarse vesicles convex upwards and inwards, but sometimes of broad, flat close-lying platforms. These are thin and very wide, each being continuous transversely for some distance round the corallite, and continuous axially with ordinary interseptal dissepiments.

The peripheral tissue is very delicate, and often crushed. The tabulae are broadly domed thin plates, very numerous; as many as 30 have been counted in 1 cm. They are irregularly interrupted by axial septal ends, and are consequently usually incomplete. Layers of stereome may be deposited on the upper surface of the horizontal tissue, especially at the junction of the dissepiments with the tabulae.

Distribution: The species is known only in New South Wales, where in addition to the type locality it occurs in the Burindi (visean) limestones in a Quarry at Taree.

Remarks: The species is very like the Devonian *Endophyllum abditum* Edwards and Haime. The occurrence in it of the close-lying thin, wide peripheral platforms is probably an expression of the *Naos* trend, although this transverse tissue cannot be traced back to modification of dilated septa. Similar tissue occurs in the other species of this genus, and there it can be shown to have arisen from *Naos*- like modifications of septa.

Aphrophyllum foliaceum sp.nov.

(Pl.11, Figs. 4,5; Pls. 12 and 13).

"*Palaeosmilia* aff. *retiformis* Etheridge MS.", F.W. Whitehouse MS quoted J.H. Reid 1930, p.35.

Holotype: F 2430 in the Department of Geology, the University of Queensland, from the Upper Viséan limestone on Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

Diagnosis: Very large *Aphrophyllum* probably compound but possibly only very gregarious simple corals; ellipsoidal in section. Peripheral area of horizontal tissue remarkably wide, occupying up to two thirds of the radius of the corallite.

Description: External characters: The corallites occur in large numbers in close proximity, and may be imperfectly contiguous; they are probably compound, but no budding has been observed. The corallites are large, very rapidly expanding to a constant diameter of 60 to 80 mm. (See Pl.12, Figs.1-3); they may remain squat and broadly turbinate, or grow to a great height, the maximum height observed being 240 mm. The calyx is deep, with domed floor and everted margin (See Pl.13, Fig.5). Epitheca is usually not preserved, thin.

Internal structures: Immature stages: A series of surfaces obtained by grinding down a tip showed that septal insertion occurs in the usual four positions, but is accelerated in the counter quadrants. The insertion of minor septa is according to the plan described by S. Smith 1913 p. 62 for *Aulophyllum*. The outline of the immature stages is usually, but not always, ellipsoidal. The plane of elongation always coincides with the cardinal and counter septa; but the halves so divided are not mirror images, even in the number of septa. The septa are pinnately fibrous in microscopic structure and are only slightly and evenly thickened. The major septa extend from the periphery towards the plane of elongation; and in the more compressed corallites their axial edges may be inclined towards the cardinal and counter septa. The minor septa remain very short.

Adult stages: The corallite matures when its peripheral zone of coarse dissepiments appears, separating the septa from the epitheca. Its outline becomes more nearly circular, but the septate area remains rather ellipsoidal, still faintly elongate in the plane of the cardinal and counter septa. The major septa are of unequal length, and extend straight towards the axis, their arrangement being thus more radial than in the young stages; their axial edges may be turned aside. The minor septa are usually half as long as the major, but rarely and sporadically the two orders become almost equal in length. The septa are separated from the epitheca by the peripheral zone of coarse dissepiments but are sometimes continued over the surface of this tissue as low crests. The septa may sometimes be dilated, and the dilatation may be regular, or, rarely, so irregular that they no longer have plane sides (See Pl.13,Fig.1). In parts of two specimens, a Neos like modification of peripherally dilated septa has occurred, and in vertical section the peripheral transverse tissue is seen to consist of numbers of fine closely packed platforms, continuous transversely, but which still show their derivation from the septa by the curves opposite the parent septa. They are, however, unconnected vertically by stereome. (See Pl.12, Figs. 1 and 2, and Pl.13, Fig.2).

The dissepiments of the interseptal loculi are small and steeply inclined, but those of the peripheral zone are usually very large and elongated in planes approaching the horizontal. This tissue is developed in alternately wide and narrow zones, as if by rejuvenescence. The strong basal platform of each wide zone is possibly epitheca and grows out from the septate area at a uniformly widening angle. On it smaller elongate cysts are laid down till a horizontal surface is attained, when the process begins again. At times these coarse vesicles are replaced by transverse tissue derived by Naos like modification of the septa, as described above.

The tabulae are broadly domed but incomplete, being interrupted by the axial ends of the major septa; they may also be reinforced centrally by smaller domed plates. They are closely packed, as many as 20 being counted in 1 cm.

Distribution: About twenty specimens were collected from the type locality. The species is also represented by three rolled and broken specimens from the Upper Viséan Lion Ck.

limestone, Stanwell, near Rockhampton, Queensland.

Remarks: In the strong expression of a trend towards lateral compression of the area with septa, and in the wide peripheral area of transverse tissue, this species is reminiscent of Humboldtia Stuckenberg (1895) p.224, and Keyserlingophyllum Stuckenberg (1895, p.219) from the Dinantian of Russia. But the types of these genera are inaccessible, so that a discussion of their relations with Aphrophyllum is not possible. The species is of interest in the acceleration of septal insertion in the counter quadrants, and in the sporadic expression of the Naos trend.

PLATE 11

Aphrophyllum Smith

Fig.1:- A.hallense Smith Polished surface. Nat. size. Brit. Mus. R 29634. Quarry near Taree, N.S.W. in the Viséan Burindi Series.

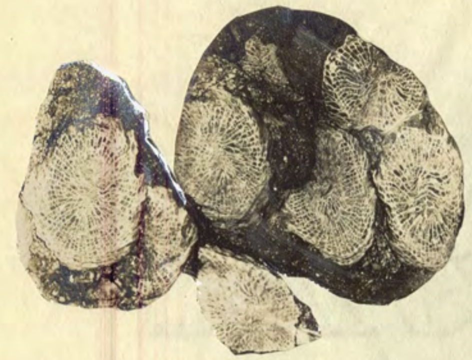
Fig.2:- A.hallense Smith. Transverse section; Bingara, N.S.W. Age Viséan (Burindi Series) University of Queensland Collection. x 2.

Fig.3:- A.hallense Smith. Vertical section ditto x 2.

Fig.4:- Aphrophyllum foliaceum nov. holotype, specimen F 2430 in the University of Queensland Collection, from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. x $\frac{1}{2}$.

Fig.5:- A. foliaceum nov.; Transverse section of paratype, E 22 in the same collection. x 2.

PLATE 11



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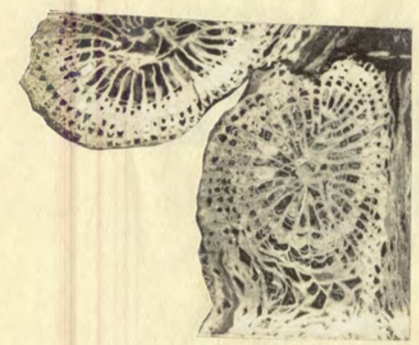

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PLATE 12

Aphrophyllum foliaceum nov. from the Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland. All sections figured below and the specimens from which they are cut are in the University of Queensland Collection, Brisbane.

All figures x 2 diameters.

Fig.1:- Diagonal section (upper surface of Fig.2) of E L.31., shows septa with Naos like modification.

Fig.2:- Vertical section of ditto.

Fig.3:- Transverse section (lower surface of Fig.2) of ditto.

Fig.4:- Transverse section of F 2536.

PLATE 12

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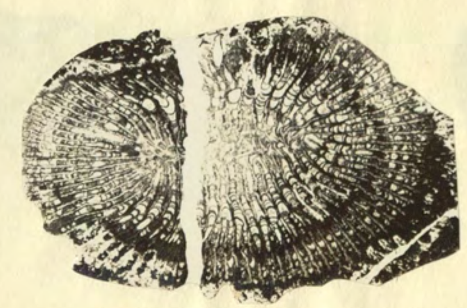


4.

PLATE 13

Aphrophyllum foliaceum nov., from the Upper Viséan Limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. All sections figured below and the specimens from which they are cut are in the University of Queensland Collection, Brisbane.

All figures x 2 diameters.

Fig.1:- Transverse section, E 20, shows the peripheral zone of dissepiments partly preserved.

Fig.2:- Transverse section F 2502.

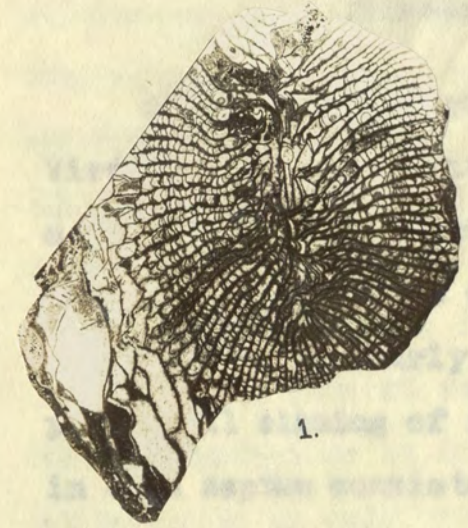
Fig.3:- Ditto, at a younger stage.

Fig.4:- Transverse section of E 21 (lower surface of Fig.5).

Fig.5:- Vertical section ditto.

Fig.6:- Transverse section of E 23. Young stage.

PLATE 13



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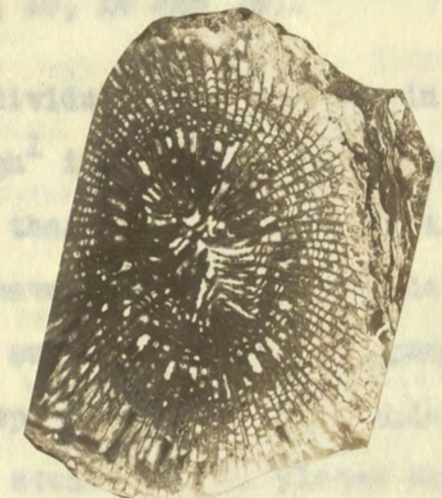

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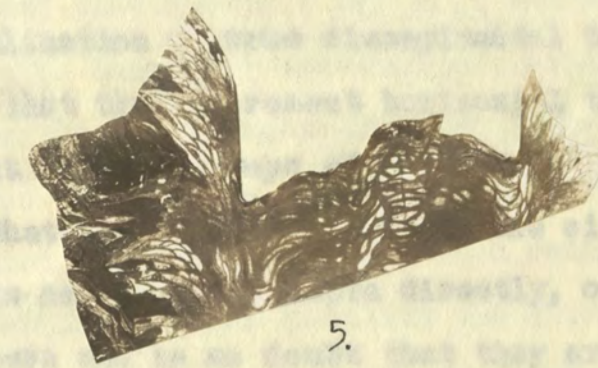

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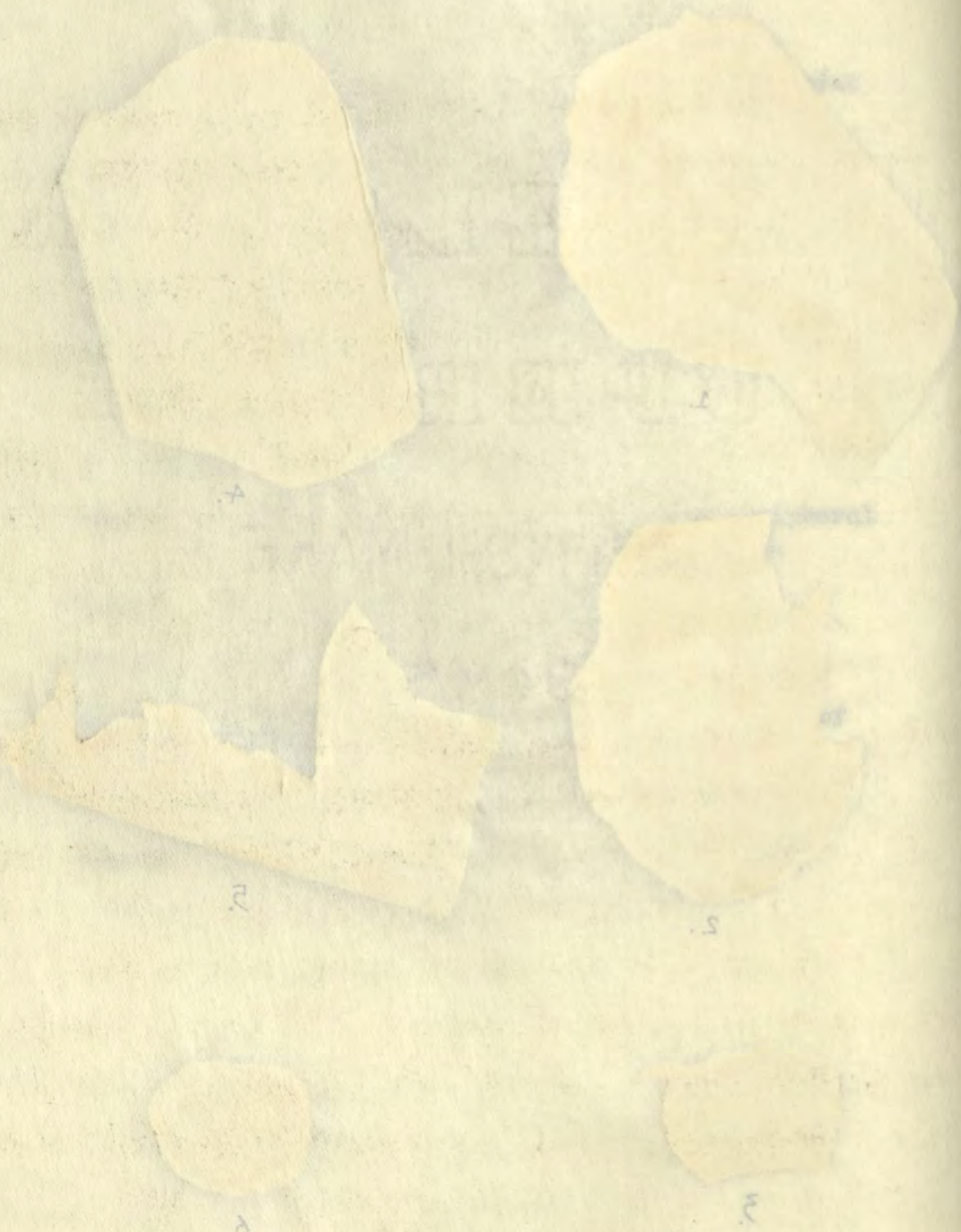


The Expression of a Trend towards Septal Modification in Certain Rugose Corals.

(Plates 5, 9, 10, 14 and 15).

Certain Rugose coral individuals which occur in the Upper Viséan limestone of Riverleigh[1] in Queensland have in common a particular modification of their septa. This is a peripheral modification of septa which have been very much dilated by stereome, particularly where such dilatation has caused the peripheral closing of interseptal loculi. The replacing tissue in each septum consists of a stack of thin plates convex upwards and inwards, as wide as the septum was thick. They are elongated parallel to the peripheral part of the calical floor, i.e. parallel to the inclination of true dissepimental tissue. This character suggests that they represent horizontal tissue, and when it is seen, that axially groups of them are continuous with dissepiments; and that laterally also groups are either continuous with groups in neighbouring septa directly, or through a narrow dissepiment, there can be no doubt that they are horizontal tissue replacing the dilated vertical system septum. Vertical continuity is attained by granules of stereome connecting two successive plates and not by rods at right angles to the plates; though very rarely, these granules may be arranged one above the other so that extremely short rods are formed.

(1) Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

Such a modification is a generic character in Symplectophyllum Hill, since it affects in varying degrees some or all of the septa at maturity. In this genus the median parts of the dilated septa may become cavernous; but this phenomenon cannot be seen to have any causal connection with the peripheral modification to horizontal tissue (Plates 1-5, particularly Plate 5).

This modification is also known in Amygdalophyllum Dun and Benson. But here it is known in only two of the four species, and in neither is it diagnostic, since it occurs sporadically at maturity in only two individuals of A. conicum Hill and one of A. inopinatum (Etheridge). In A. conicum it arises in dilated contiguous septa (See Plates 9 and 10); but whether this is so in A. inopinatum cannot be ascertained, since the earlier parts of the corallite are broken off (See Plate 7, Fig.2). In the former the details are clear and well executed; but in the latter execution seems to have been much rougher.

The third genus occurring at this locality and showing this modification is Aphrophyllum Smith. Two of about 20 individuals of A. foliaceum Hill show it sporadically in dilated septa not quite in contact (Plate 13, Fig.2).

It is seen in a third individual of A. foliaceum occurring at a different locality at the same horizon - the Lion Ck. limestone at Stanwell[1], Queensland (See Pl.12, Figs. 1 and 2) -

(1) ~~16 miles south of Bingara, Parish of Hall, N.S.W.; and Quarry at Taree, N.S.W.~~

which the New South Wales species of Aphrophyllum, A. hallense Smith, occurring in two localities[1] also shows this modification. In the New South Wales species, however, the plates of neighbouring septa are continuous in platforms, and curves denoting each septum in these continuous platforms are flattened out, while the connecting stereome granules disappear. The appearance of finished craftsmanship is thus lost, and the details appear only roughly sketched (Pl.11, Figs. 2 and 3).

Thus there is in Carboniferous corals at various localities in Eastern Australia, a tendency or trend for dilated septa to become modified peripherally in mature parts of the corallite into horizontal tissue vertically connected by stereome granules. Its expression can in one case be used as a generic character, but is otherwise quite sporadic, and may be found with much minuteness and exactness of detail, or only roughly sketched out. While the septa affected are always strongly dilated, it does not seem absolutely necessary that they should be in contact. In their unmodified condition these dilated septa were pinnately fibrous.

The above corals are the only ones known to the author to show this curious modification in the Carboniferous. Nagatophyllum Ozawa (1925 pp.79-80, Pl.xiii, Figs.1-5) from the Dinantian of Japan would seem from the plates to have septa peripherally modified into similar stacks of transverse plates;

(1) 16 miles south of Bingara, Parish of Hall, N.S.W.; and Quarry at Taree, N.S.W.

but without examination of the actual material we cannot be sure.

In the Middle Devonian of Torquay, England, "Chonophyllum perfoliatum auctt. shows sporadically a somewhat similar peripheral modification of dilated septa with horizontal tissue. Here the zone affected is very wide, and the septa are not always in contact; the stacks of plates formed are kept in vertical continuity by short rods at right angles to the horizontal tissue. In this species the structure is often masked by thin smears of the stereome of dilated septa remaining unmodified (See Plate 14, Figs.1-6). Frech's figure of Cyathophyllum tinocystis (1885, p.28, Pl.1, Fig.1), from the Lower Upper Devonian of Grund, shows this type of modification also, but material for examination is not to hand. The forms from the Lower Devonian of Bohemia which were placed by Pocta (1902, p. 100) in the genus Chonophyllum show similar modifications. In America (Canada West) this modification in the Devonian species Naos magnificus (Billings) has been described by Scherzer (1892, pp.259-62, Pl.viii, Fig.5).

In the Silurian, (Niagaran) of Arctic America, the genus Naos Lang (1926, p.428) shows a perfect development. Here the horizontal tissue is widely spaced and replaces dilated septa separated by narrow dissepimental alleys, and vertical continuity is attained by long, strong vertical rods at right angles to the transverse tissue (See Pl.15, Figs.1-3). Since this genus shows the most perfect development of the modification, (for in later occurrences the highly developed vertical rods tend to be represented by granules of stereome), the trend might be called the Naos trend.

This type of septal structure is a modification or degeneration; in its sporadic occurrence and varying degree of perfection in expression it resembles any other trend in corals, whether such a trend affects only vertical or horizontal elements or both. The sporadic development of this septal structural trend deserves emphasis. The governing factor seems to be neither chronological nor systematic, nor the nature of the septal dilation. The septa are of the ordinary pinnately fibrous type in the Australian genus Symplectophyllum the only ones in which the structure of the unmodified septa is known.

PLATE 14

Compare Plates 5, 9 & 10.

Fig.1:- Part of transverse section of "Chonophyllum perfoliatum" auctt. No.168 Sedgwick Museum, Cambridge; from the Middle Devonian of Ramsleigh qy., S. Devon, showing the modified septa x 2.

Fig.2:- Tangential section of ditto. x 2.

Fig.3:- Longitudinal section of ditto. x 2.

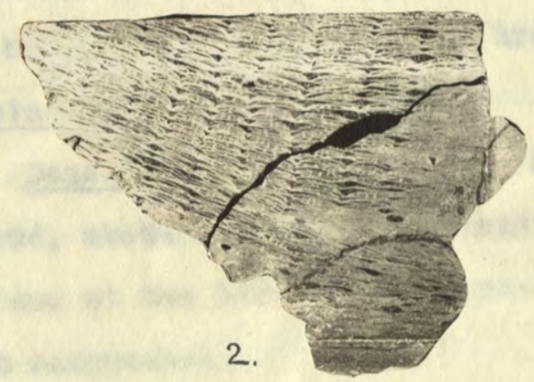
Fig.4:- Transverse section of Naos pagoda Lang from the Niagara Formation (= Wenlock) of Melville I., Arctic America, R 25163 in the British Museum (reproduced from Lang 1926, Pl.xxx, Fig.1). x 2.

Fig.5:- Radial section of the same specimen, reproduced from Lang 1926, Pl.xxx, Fig.2. "The section is not truly radial; but on the left it lies mainly in the plane of a dissepimental alley, and on the right mainly in the plane of a septum. The globular structures are dissepiments; the saucer like horizontal structures and the piller-like vertical structures are septal tissue." x 2.

Fig.6:- Tangential section of the same specimen, reproduced from Lang 1926, Pl.xxx, Fig.3.

PLATE 14


1.


2.


3.

Skeletal Malformation in an Australian Carboniferous Coral.

(Plate 15).

A fragment of a large simple Rugose coral from the Upper Viséan limestone of Riverleigh[1] in Queensland shows undoubted skeletal malformation. This obscures the structure of the axial area and affects groups of septa in increasing degree. Because of its malformation it is impossible to say with certainty to which species the coral belongs, but its septal, dissepimental and outer tabulate structures are like those of Amygdalophyllum inopinatum (Etheridge fils.).

Description: The fragment of corallite was slightly curved, about 8 cm. long, expanding from a diameter of about 3·5 cm. at the bottom to 4·5 cm. at the top, where it was somewhat compressed.

The unaffected parts of the corallite show the following internal structures. The septa are thin, and leaf like, and crowded, about 66 of each order. The major septa are long, extending into the axial area, where they are masked by malformation. The minor septa attain half this length. The dissepiments are numerous, elongate, and not very regular; the inner ones are smaller and more steeply inclined than the outer. Only

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(1) Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

a little of the outer part of the tabulate area is not malformed, but it can be seen that the tabulae are incomplete, and that often two series of plates, an inner and an outer, are present. The outer series is most distinct when the inner dissepiments are less steeply inclined, and consists of numerous flat lying concave plates. It is absent when the inner dissepiments are so steeply inclined as to be almost vertical and thus to form a wall, and the tabulae of the inner series abut directly on to it. These are large, convex and steeply arched upwards towards the axis. It is impossible to say whether they abutted originally on to a columella, or merely formed a dome as in Palaeosmilia. Malformation affects an increasing area in the corallite. In the lowest part of the fragment, it is pronounced in the axial area, and in a group of septa forming a segment 6 mm. in width at the epitheca. A second, smaller group in which five septa are malformed extends from the axial area not quite to the epitheca. The affection of these two segments increases with the age of the corallite, while a third group of septa also becomes affected, the malformation rapidly spreading outwards from the axial area to the epitheca. On the upper surface of the fragment, fully half of the corallite is malformed. The malformed structures, and also the adjacent normally developed elements are often macerated.

In each of the affected areas, normal development of the vertical and horizontal elements of the coral skeleton no longer takes place. The first stage is the dilation of the septa with ~~xxx~~ stereome, starting from the axial ends, spreading from the earlier affected axial area, until interseptal loculi are practically absent. Then these dilated vertical elements become discontinuous, or extremely tortuous in course, or even suppressed altogether. The normal horizontal elements are entirely suppressed, but in the irregular loculi formed by the discontinuity or suppression of the dilated vertical elements, simple, widely spaced flat plates mayarise, which may or may not be horizontal.

The stereome is deposited as a lining to the septa (usually on both surfaces but sometimes on only one), and occasionally on the upper surfaces, or horizontal tissues. Microscopic investigation shows no trace of fibrosity, but darker bands may be discerned running parallel to the surface which the stereome is lining (See Pl.15, Figs. 4 and 5).

Remarks: Amongst the various species occurring at the same locality and horizon, only one species, namely Amygdalophyllum inopinatum (Etheridge fils) agrees in all particulars with the normally developed horizontal and vertical elements of the malformed specimen. But this specimen cannot be proved to be columellate, and therefore can only doubtfully be referred to this species.

It is idle to speculate on the nature of the adverse conditions causing the malformation; but it is important to note that here the deposition of stereome linings is without doubt due to adverse conditions. The structure of this particular stereome, undoubtedly deposited as a result of adverse conditions, is obviously of importance in any discussion on the deposition of stereome in Rugose corals.

PLATE 15

Skeletal Malformation in ? A. inopinatum (Etheridge fils) from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

The slides figured below and the specimens from which they are cut are in the University of Queensland collection.

Fig.1:- Transverse section of F 2460; upper surface of Fig.2. x 2.

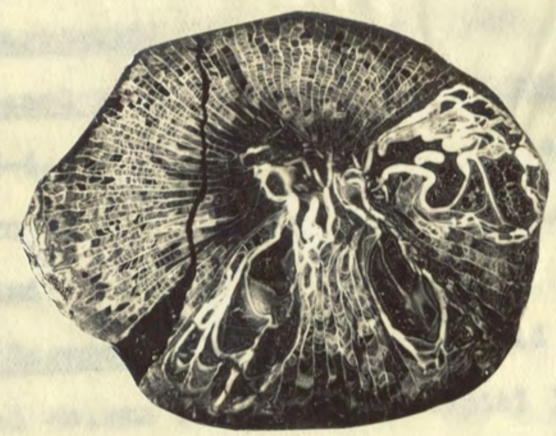
Fig.2:- Longitudinal section of ditto. x 2.

Fig.3:- Transverse section of ditto; lower surface of Fig.2. x 2.

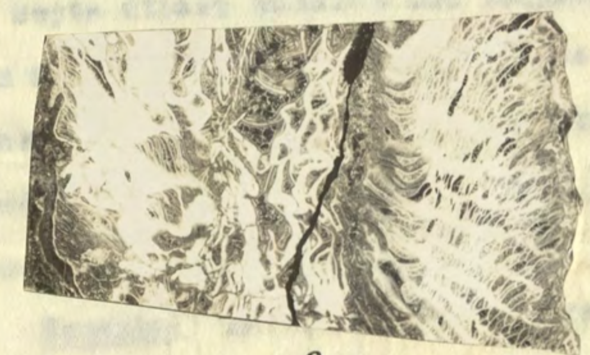
Fig.4:- Transverse section of ditto enlarged, showing structure of stereome x 10.

Fig.5:- Longitudinal section of ditto enlarged showing structure of stereome. x 10.

PLATE 15



1.



2.

3.

CARCINOPHYLLUM

Carcinophyllum Thomson 1880; pp.241-244.

Genotype: Carcinophyllum kirsopianum Thomson 1880, pp.243-4. Text Figure 3 on p.241, and Pl.II, Figs.7, 7a, and 7b, from the Lower Carboniferous of Arbigland, Dumfries, Scotland.

Diagnosis: Simple or dendroid rugose corals, with a central column in which the septal lamellae are dilated, irregular, and anastomosing, and a mesial plate is present. The septa dilate towards the periphery of the corallum, and form a stereozone; but through most of the corallum they are separated from the epitheca by coarse dissepiments. The tabulae between the central column and the dissepiments are widely spaced, and are flat or sagging.

Remarks: In the British representatives of this genus, the peripheral stereozone is never perfect owing to the excessive development of the lonsdaleoid trend; but in the Australian species, the stereozone is only infrequently broken through, and that at maturity.

Carcinophyllum patellum nov. sp.

(Plate 17)

Holotype: F 2534 (2 slides and 3 pieces) in the Department of Geology, the University of Queensland; from the Upper Visean limestone of Latza's Farm, Portion 22, Parish of

Riverleigh, near Mundubbera, Queensland. A paratype has been placed in the Sedgwick Museum, Cambridge.

Diagnosis: Small, simple or dendroid Carcinophyllum; the central column is dibunophylloid and dense with stereome; the stereozone is wide and only infrequently broken through by the withdrawal of the septa. Gemmation is calicular.

Description: The corals when simple are slenderly conical, attaining a maximum diameter of 13 mm. The average diameter is 10 mm. at a height of 40 mm. The dendroid forms arise by calicular budding, three or four hystero corallites being given off from the parent calyx. The epitheca shows wide arched rugae, with deep narrow furrows.

The septa are of two orders, usually about 24 of each, but there may be as many as 30. They are pinnately fibrous, and thick, being lined or invested with fibrous stereome. The major septa are usually discontinuous with the lamellae of the central column. The minor septa are very short, and the peripheral stereozone is as wide as the length of the minor septa. Its continuity is usually due to the major and minor septa being so thick as to be in contact, but any interseptal loculi may be filled by fibrous stereome resting on horizontal tissue and lining (investing) the already dilated septa. In mature corallites, the septa may withdraw from their bases at the epitheca, and large dissepiments convex upwards and inwards arise, on which the septa may be represented as stout crests. Since loculi rarely occur between the major and minor septa, fine dissepimental tissue is usually absent.

Small, thin concave tabulae occur between the central column and the stereozone, widely spaced, and seldom invested with stereome.

The central column, whose diameter may be one third that of the corallite, consists of a mesial plate with a few sinuous vertical lamellae abutting on to it, and long highly arched tabellae; the vertical elements may be so dilated and so much stereome may be deposited on the upper surfaces of the tabellae that the column may be solid. In rare instances it is free from stereome, and in this case the septa are less dilated, and the tabellae are continuous with the tabulae (See Pl.16, Figs.15-18).

Remarks: This species, known only from the type locality and horizon, is remarkable for its tendency to become dendroid and for its constant possession of a stereozone. The stereozone, in that it is as wide as the minor septa are long, and in that it may be formed by the dilated septa coming into contact, resembles the stereozones of the Permian corals of Timor, such as "Caeinophyllum" wichmanni (Rothpletz). The consequent repression of interseptal dissepiments is also characteristic of the Permian corals, but in the latter the peripheral withdrawal of the septa, with the formation of large dissepiments does not occur. Amongst the English representatives of the genus, C.patellum resembles C.densum Ryder, from the D_2 zone the most closely.

PLATE 16

Carcinophyllum patellum nov. from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland; the sections figured below and the specimens from which they are cut are in the University of Queensland collection.

All figures (except Fig.1) x 2 diameters.

Fig.1:- External view of holotype.(Nat.size), F 2834.

Fig.2:- Transverse section of ditto.

Fig.3:- Transverse section of F 2836

Fig.4:- Vertical section of ditto.

Fig.5:- Transverse section of F 2432.

Fig.6:- Transverse section of F 2505, a very stereoplasmid individual.

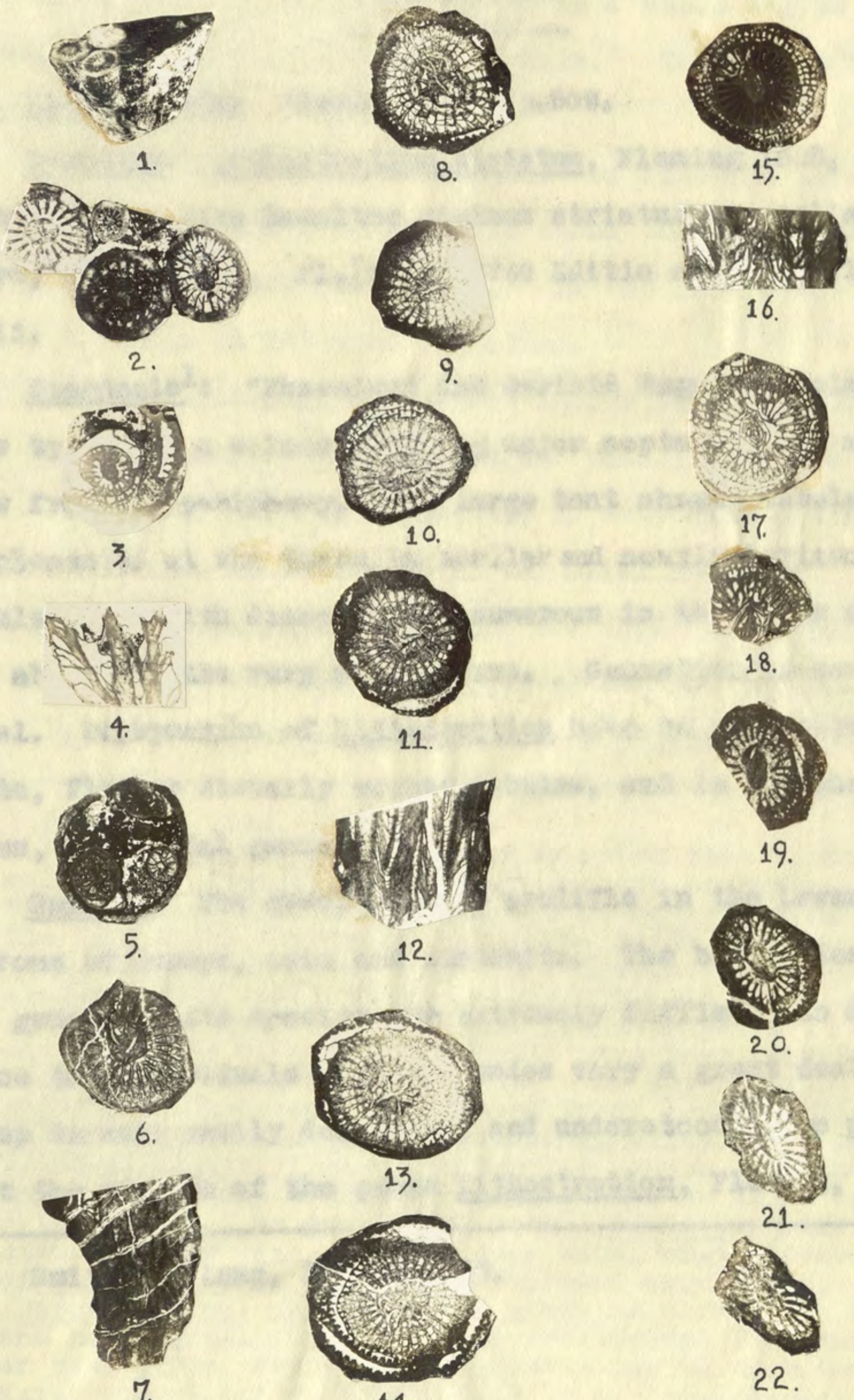
Fig.7:- Vertical section of ditto.

Figs.8-14:- Sections (in series) of E 11.

Figs.15-18:- Sections (in series) of F 2460, a less stereoplasmid individual.

Figs.19-22 :- Sections of E 12.

PLATE 16



LITHOSTROTION

Lithostrotion Fleming 1828, p.509.

Genotype: Lithostrotion striatum, Fleming 1828, p.509 = Lithostrotion sive Basaltes minimus striatus et stellatus, Lhwyd, 1699, p.124. Pl.[xvi]; 1760 Editio altera, p.125, Pl. xxiii.

Diagnosis[1]: "Phaceloid and cerioid Rugose Corals which have typically a columella, long major septa" which may withdraw from the periphery, "and large tent shaped tabulae, usually supplemented at the theca by smaller and nearly horizontal tabulae; and with dissepiments numerous in the large species but absent in the very small forms. Gemmation is non-parricidal. Diphymorphs of Lithostrotion have no columella, short septa, flat or distally arched tabulae, and in the phaceloid forms, parricidal gemmation."[1]

Remarks: The genus is very prolific in the Lower Carboniferous of Europe, Asia and Australia. The boundaries of both the genus and its species are extremely difficult to define, since the individuals of all species vary a great deal. The group is more easily dealt with and understood if we postulate that the members of the genus Lithostrotion, Fleming, all

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(1) Smith and Lang, 1930, p.178.

possess potentialities to follow definite developmental trends[1]; i.e. characters common to the group as a whole may be expressed or suppressed in different individuals. The common trends in Lithostrotion are:-

1. The progressive development in external form usual in Rugose corals from dendroid forms through phaceloid and cerioid to asteroid forms. In the last stage there is a change in internal structure.

2. The eridophylloid trend; i.e. a tendency for neighbouring corallites in dendroid and phaceloid forms to become united by lateral outgrowths of extrathecal tissue.

3. Trends in structure in the axial region.

(a) The diphyphylloid trend; the septa withdraw from the axis, the columella disappears, and the tabulae become flat or distally arched.[2] Diphyphylloid individuals

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(1) See Lang, 1923, pp. 120-136.

(2) In this connection it should be noted that amongst groups related to Lithostrotion and at present recognised as distinct genera, the axial structure of Nemistium Smith, and the long axial septum of Dorlodotia Salée and Thysanophyllum Minus Nich. and Thoms. possibly represent intermediate halted stages in the development of diphyphylloid trend, or may be quite independent developments. In many cases it is uncertain whether forms without a columella have been derived from columellate forms or vice versa. In Orionastraea lonsdaleoides nov., however, the forward trend leading from cerioid to astraeoid forms is accompanied by columellate corallites becoming diphyphylloid; the tabulae become flat and complete, and not distally arched or divided into an iner and an outer series. No corallites with a Nemistium like axial structure are seen, but the long axial septum characteristic of Thysanophyllum minus is a frequent occurrence. [Diphystrotion] mutabile nov. gives no clue as to whether the non-columellate corallites are derived from the columellate or vice versa, but the same remarks may be made about its axial structures as about those of O. lonsdaleoides.

(diphymorphs) have been separated off from the typical Lithostrotions, i.e. those with long septa, by Smith and Lang (1930, p.177) as genomorphs of the genus. [A genomorph of Lithostrotion is understood to be a group of individuals in which an individual but not a phyletic trend common to all members of the genus Lithostrotion reaches an expression whereby the group is well demarcated from typical Lithostrotion. A diphymorph is a genomorph in which the trend concerned is the diphyphylloid trend].

(b) A clisioid trend; the more or less complete tabulae of the typical forms become replaced by small, incomplete tabulae or tabellae, which may become arranged in an axial and a periaxial series, the columella being retained. Phaceloid and cerioid groups of individuals in which the tabulae are replaced by tabellae (not arranged in axial and periaxial series) have been separated off by Schindewolf[1] into the subgenera Cystidendron Schindewolf and Cyststrotion Schindewolf. If the conception genomorph be accepted, then these two might also logically be regarded as genomorphs.

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(1) Schindewolf, 1928, p.148-51 also separated the columellate Lithostrotions with complete tabulae and fine interseptal dissepiments into two subgenera; Siphondendron McCoy (phaceloid) and Lithostrotion Fleming (cerioid).

(c) A cionoid trend; in which the columella becomes very large, may be expressed independently of the clisioid trend, or the same individuals might show both. Cionodendron Benson and Smith was erected to receive 2 specimens which might be regarded as Lithostrotion with abnormally large columella.

4. The Lonsdaleoid trend; the septa retreat from the epitheca, leaving a coarse peripheral ring of dissepimental tissue, on which they may be represented as crests.

A cerioid group showing this trend well developed has been separated off by Yabe and Hayasaka (1915, p.93) as a sub-genus Lithostrotionella Y. and H. This might also be regarded as a genomorph. Except where mutually exclusive, all these various trends may be found in one and the same individual; but usually only one is pronounced; and the individuals thus distinguished may be united in genomorphic groups. As far as we know genomorphs may arise at any period within the range of the genus.

It is to be noted that it is convenient to regard as a genus the group of forms included in Orionastraea Smith, which differs from typical Lithostrotion in the manifestation of two internal structural trends in an advanced stage - that due to the change from cerioid to asteroid form, and the diphyphylloid Trend. Orionastraea merges into Lithostrotion in the species O. ensifer.

If the groups Dorlodotia Salée and Thysanophyllum Minus Thoms. and Nich. be derived from Lithostrotion Fleming, then here also two trends have been concerned.

Remarks on the Australian species of Lithostrotion Fleming: Three Australian species of Lithostrotion Fleming, L.columnare, L.arundineum and L.stanvellense have already been described by R. Etheridge Jr. (1900, p.10), who placed them provisional ly in this genus, and their status was confirmed by Dr Stanley Smith (1920, p.61). Etheridge's three species are here re-described on topotypic material and on specimens from other localities in Queensland and New South Wales. Variability in the Australian species seems to be caused by differences in the degree of development of trends which all the individuals possess in common; and in such variability the Australian species agree with their European congeners. Also, while in some localities a species is more or less variable, in other places, more rarely, no variation is apparent, and the species may be spoken of as having reached a stable expression; i.e. in some localities a particular expression is only one amongst a whole series, but in one locality it is isolated. It is possible, then, that sometimes the expression of a trend is a function of the geography of the individual.

The Australian species "agree in all essential characters with their European congeners. Yet as a group they present certain distinctive characters."[1] These differences may be summed up as follows:-

(1) S. Smith, 1920, p.61.

1. "Columella. This is usually much stouter than in British species.
2. Tabulae. The tabulae in the Australian species are to a great extent replaced by arched tabellae; or they may be sharply bent, as in Cionodendron."[1] In the case of L.columnare and L.arundineum there is moreover a marked tendency for the tabulae to become strongly differentiated into an axial and a periaxial series, the inner series being strongly arched, and fairly uniform, and the outer irregularly disposed, and on the whole more widely separated, some being nearly flat and horizontal, and others steeply inclined and more curved.
3. "Septa. The septa exhibit a marked tendency to become disunited from the epitheca in the adult stage."[2] Axially the septa are typically grouped, and, whether grouped or not, confluent with the columella.
4. "Dissepiments. Dependent upon the disruption of the septa from the epitheca, the external dissepiments (not being intersepted by the septa) frequently form an outer zone entirely built up of coarse dissepimental tissue as in Lonsdaleia.

It is the prevalence and combination of these characters, and not the presence of any one of them, that distinguishes the Australian from the British forms, since in the less typical examples among the British species such features may occasionally be noted."[2] In other words we may say that the British and

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(1) Benson and Smith, 1923, p.169.
(2) Because of this replacement Schindewolf (1928, p.149 loc.cit.) placed these species in his sub-genera Cystidendron and Cystistrotion.

Australian species possess in common the same trends; but certain of these tend to be expressed more strongly in one continent than in the other.

Lithostrotion columnare Etheridge.

(Plate 17).

Lithostrotion (?) columnare R. Etheridge Jr. 1900, p. Pl.I, Fig.1; Pl.II, Figs. 2, 3, 4, and 5.

Lithostrotion columnare Eth. fils., S. Smith, 1920, p.61, Pl.V, Figs.1, 2 and 3.

Cystistrotion columnare (Eth. fils.) Schindewolf, 1928, p.149.

Type Material: in the Queensland Geological Survey Collection from the Lion Ck. Limestone, Stanwell, near Rockhampton. Age, Upper Visean. Topotypes have been placed in the Sedgwick Museum, Cambridge.

Diagnosis: Large cerioid Lithostrotion comparable in size with the British L. arachnoideum (McCoy), showing great variability; major septa confluent with strong columella; minor septa long and dissepimental tissue copious; tabulae incomplete, variable. Gemmation intermural.

Description: The corallum is compound, large, cerioid, or occasionally partly asteroid. The corallites are long and straight with an average diameter of 10 mm.[1] The epitheca of each corallite is variably developed, and may be thickened, or thin and irregular, or as a line of vesicles filled with secondary deposit. There are 20 to 25 stout septa of each order; their peripheral edges are usually in contact with the epitheca, (See Pl.17, Fig. 5) but may sometimes withdraw and be separated from it by dissepiments (the lonsdaleoid trend) See Pl.17, Fig. 6); or they are occasionally irregular in course and confluent with those of contiguous corallites (the asteroid trend) See Pl.17, Fig.7). The axial edges of the major septa are confluent with the columella, either separately or conjoined in groups. The minor septa attain two thirds the length of the major. Dissepiments are small, numerous, (4 to 7 rings), and regular except at the epitheca where they may be coarsely developed and separate the septa from the epitheca (P.17, Fig.6) (the lonsdaleoid trend); or they may break through the epitheca and be continuous with those of neighbouring corallites (Pl.17, Fig.7)(the asteroid trend). The inner ring of dissepiments is sporadically invested with stereome. The columella is styliform or cylindrical, and usually thickened. The tabulae are incomplete; they are to a great extent replaced by strongly arched tabellae, convex upwards and outwards and varying in size

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(1) The Riverleigh individuals (See Pl.17, Figs. 8 and 9) are much smaller, with a constant diameter of 5 mm.

(See Pl.17, Figs. 2 and 4); or more rarely (and this is a constant character in Riverleigh specimens) they may be strongly differentiated into an axial and a periaxial series, the inner series being strongly arched and fairly uniform, and the outer irregularly disposed and on the whole more widely separated, some being nearly flat and horizontal and others steeply inclined and more curved (See Pl.18, Figs. 3 and 9). Gemmation is always intermural.

Distribution: In limestones of Viséan age, at

1. Lion Ck., Stanwell, near Rockhampton, Queensland.
2. Horton R., between Eulowrie and Pal Lal, New South Wales.
3. Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

Remarks: Variability is very pronounced in the Lion Ck. and Horton R. material; but the Riverleigh corallites have a constant expression, which however, is seen in some Lion Ck. specimens. The variability can be said to be due to sporadic weak expressions of the lonsdaleoid and the astervoid trends, and of trends leading to incompleteness of the tabulae and to the arrangement of the replacing tabellae in axial and periaxial series. The only one of these trends expressed in the Riverleigh material is the last, and the tabellae are always arranged in axial and periaxial series. This material is also distinguished by the constant small size of its corallites

(5 mm. diameter), and correspondingly smaller number of septa (16 of each order). The reason of this stabilization, whether difference of horizon or habitat or some other cause, has not been ascertained.

Lithostrotion stanvellense Etheridge.

(Plate 18).

Lithostrotion (?) stanvellense Etheridge fil. 1900, p. Pl.I, Fig.5, Pl.II, Figs. 7,8.

Lithostrotion stanvellense (Eth. fil.,)S. Smith, 1920,p.63, Pl.III, Figs.1,3,4m5,6, Pl.IV, Figs. 1, 1a, 3.

Cystidendron stanvellense Eth. fil. Schindewolf, 1928,p.149.

Type Material: in the Queensland Geological Survey Collection from the Upper Visean Limestone of Lion Ck., Stanwell, near Rockhampton, Queensland. Topotypes have been placed in the Sedgwick Museum, Cambridge.

Diagnosis: Large dendroid Lithostrotion comparable in size to the British L.martini Edwards and Haime; major septa confluent with a strong columella; minor septa short and dissepimental zone narrow; tabulae typically incomplete. Gemmation lateral. The septa may withdraw from the columella and budding is then calicular.

<u>Description</u>: The corallum is dendroid (See Pl.18, Fig.1) or inclined to caespitose, and large, and the corallites are then irregular in direction of growth, long, and usually between 8 and 10 mm. in diameter, though diameters of 5 mm. and 15 mm.[1] are not infrequent; the epitheca shows well marked growth accretions, and indistinct rugae. A phaceloid[2] corallum is also known, in which the corallites are close and parallel, and may attain the gigantic diameter of 22 mms., the epitheca being regularly ornamented with joint growth rings and rugae.

The septa are straight, usually unthickened, and vary in number according to the diameter of the corallite from 24 to 44 of each order. Typically the axial edges of the major septa are grouped and the resultant combined edges are confluent with the columella (See Pl.18, Fig.2); often[3] however, the septa fail to make contact with the columella (See Pl.18, Fig.3); and in one corallum[4] they are withdrawn so far as to be little longer than the minor septa; this weakly diphymorphic corallum shows the calicular budding typical of diphymorphs, although the columella is present (See Pl.18, Fig.6). The minor septa are short, and attain little more than one third the length of the major. The dissepimental zone is narrow and consists of two or

(1) Large forms are more common at Riverleigh than elsewhere.
(2) From Riverleigh.
(3) Especially at Riverleigh.
(4) Also from Riverleigh.

three rows of small irregular vesicles, the inner series extending not quite to the axial edges of the major septa; this inner series may be invested with stereome. Sporadically the dissepiments of the peripheral series may cause the septa to be discontinuous with the epitheca (the lonsdaleoid trend). The columella is thickened, and may be round, oval, fusiform or radiate. The tabulae are usually incomplete (See Pl.18, Fig.5), being replaced by copious tabellae of various sizes, convex upwards and outwards, sometimes with short horizontal plates between them and the dissepiments. Gemmation is typically lateral[1], but in the weakly diphymorphic corallum mentioned above, it is calicular, and the relation between the neo- and octavo-tissues is the same as described by Smith and Ryder (1927, p.339) in Stauria favosa.

Distribution: In the Upper Viséan limestones of

1. Lion Ck., Stanwell, near Rockhampton, Queensland.
2. Hall's Ck., Parish of Hall, Bingara, New South Wales.
3. Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.
4. Crinoid Mt., Diglum, Barmundoo Goldfield, near Gladstone, Queensland.

---

(1) One case was observed in which the bud and parent had a common epitheca, but the corallites were malformed at the contact (See Pl.18, Fig.9).

Remarks: The Stanwell material is typical, with a constant expression, and is notable for the incompleteness of the tabulae and the strength of the columella. The Bingara and Riverleigh material however, is very variable. The Bingara corallites vary in size (See Pl.18, Figs.7 and 8) from 5 to 11 mm., the tabulae are usually complete, the lonsdaleoid trend is weakly expressed and there is much investment by stereome of septa, columella and inner ring of dissepiments. At Riverleigh the species is very common, and the coralla and corallites are usually very large. One large phaceloid and one weakly diphymorphic corallum with calicular budding have been collected here. The locality is notable for the weak development of the diphyphylloid trend, shown by the septa failing to make contact with the columella; the tabulae may be complete or incomplete, and the lonsdaleoid trend is weakly expressed. The Barmundoo material is referred to L. stanvellense by growth form only, since it is too crystalline to section.

Lithostrotion arundineum Etheridge.

(Plate 12).

Lithostrotion (?) arundineum Etheridge fil. 1900, p.19, Pl.I, Figs. 3,4; Pl.II, Fig.6.

Lithostrotion arundineum Eth. fil., S. Smith, 1920, p.63, Pl.IV, Figs.2, 2a.

Cystidendron arundineum (Eth.fil.) Schindewolf, 1928, p.149.

Type Material: In the Geological Survey of Queensland Collection from the Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland. Topotypes have been placed in the Sedgwick Museum, Cambridge.

Diagnosis: Phaceloid *Lithostrotion* comparable in size to the British *L. irregulare* auctt.; the major septa are typically confluent with the strong columella; dissepimental zone is very narrow; the tabulae are incomplete, the vesicles being arranged in an axial and a periaxial series. Gemmation is lateral.

Description: The corallum is phaceloid and large; the corallites are long, straight, parallel, close, often in contact, 4-5 mm. in diameter; they are thinly epithecate, with delicate growth rings and distinct rugae (Pl.19, Fig.1). There are about 20 septa of each order, straight, and sometimes thickened. Typically the axial edges of the minor septa are confluent with the columella (Pl.19, Fig.2), either previously conjoined in groups or independent; but they very often fail to make contact with the columella, abutting instead on the axial Tabellae[1]. The minor septa are very short, less than half the length of the major. Dissepiments are correspondingly few, and are small and regular, the inner ring being usually invested with stereome. The strong columella is cylindrical or styliform, often much thickened. The tabulae are incomplete[2] and the replacing tabellae are arranged in an axial series of strongly arched and fairly uniform cysts, and a periaxial series of irregularly disposed and rather more widely separated plates, some being nearly flat and horizontal, and others steeply inclined (Pl.19, Fig.3). Gemmation is always lateral.

Distribution: In ~~Uxxxx~~ Viséan limestones at

1. Lion Ck., Stanwell, near Rockhampton, Queensland.
2. Near the Police Station, Horton R., County Murchison, New South Wales.
3. Between Enlowrie and Pal Lal, Horton R., County Murchison, New South Wales.
4. Crinoid Mt., Diglum, Barmundoo Gold Field, Gladstone District, Queensland.
5. Mt. Grim, Gladstone District, Queensland.
6. Near Texas, South Queensland. (?)

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(1) At Stanwell and the Horton R.
(2) Except at Mt. Grim.

Remarks: The Stanwell material is stable save for a frequent slight expression of the diphyphylloid trend. This is seen also occasionally in the Horton R. material, which, however, is also notable for the stereoplasmid thickening of the vertical elements, particularly the columella (Pl.19, Figs, 4, 5 and 6), which attains a size comparable with that of *Cionedendron columen* Benson and Smith[1] (See Pl.19, Figs. 9 and 10). The Barmundoo material is referred to *L.arundineum* on external form only, since it is too crystalline to section. The Mt. Grim material also is rather crystalline. In the few corallites in which the structure is clear, all the septa reach the columella, and the tabulae are complete (Pl.19, Figs. 7 and 8). All that can be said of the sheared Texas material is that it belongs to *Lithostrotion* more probably than to any other genus. It resembles *L. arundineum* in size and form, and appears to have a columella. If it be *Lithostrotion* then the 'Gympie Series' of the Texas District includes Lower Carboniferous beds.

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(1) Were it not for the greater number of septa, and the sharply bent tabulae *Cionodendron columen* Benson and Smith, might be regarded as *L. arundineum* in which the columella is developed even more strongly than in the Horton R. specimens.

PLATE 17

Lithostrotion columnare Etheridge

The sections figured below and the specimens from which they are cut are in the University of Queensland collection.

All figures (except Fig.1) x 2 diameters.

Fig.1:- Topotype (from Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland)F Natural size

Fig.2:- Vertical section showing typical incomplete tabulae. Topotype; L. 31. 6.

Fig.3:- Vertical section showing tabulae in two series. Topotype; F 2538.

Fig.4:- Vertical section showing typical incomplete tabulae. Slide F 6541 from specimen A.M. 186 in Australian Museum from the Viséan Limestone of Horton R., between Eulowrie and Pal Lal, N.S.W.

Fig.5:- Transverse section showing typical aspect. Topotype L.31. 8.

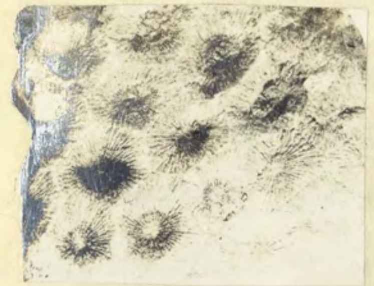
Fig.6:- Transverse section showing septa withdrawing from periphery. A.M. 331 or 186, Horton R. Between Eulowrie and Pal Lal. F 6543 in Australian Museum.

Fig.7:- Transverse section showing disappearance of epitheca. Topotype L.31. 6.

Fig.8:- Transverse section, F 2513 typical of the species occurring in Upper Visean limestone at Latza's Farm, Portion 22, Parish of Riverleigh near Mundubbera, Queensland.

Fig.9:- Vertical section, ditto, showing the two series of tabulae.

PLATE 17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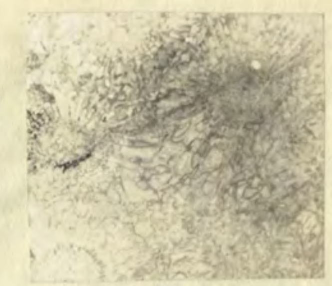
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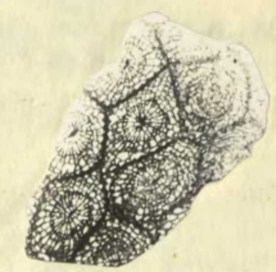
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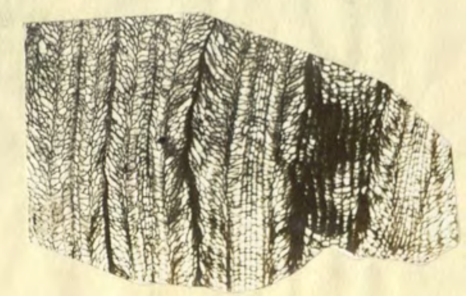
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PLATE 18

Lithostrotion stanvellense Etheridge

The sections and specimens referred to below are in the University of Queensland collection.

All figures (except Fig.1) x 2 diameters.

Fig.1:- External appearance x 1, from Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland (Upper Viséan) F x

Fig.2:- Transverse section same locality as Fig.1; showing septa confluent with columella. Typical.

Fig.3:- Transverse section showing septa withdrawn from columella, same locality. F 2392.

Fig.4:- Vertical section showing complete tabulae (from large phaceloid corallum F 2383) same locality.

Fig.5:- Vertical section showing incomplete tabulae (from typical dendroid corallum) F x, same locality.

Fig.6:- Transverse section of large corallum budding calicularly, and with septa much withdrawn from columella, from Riverleigh.

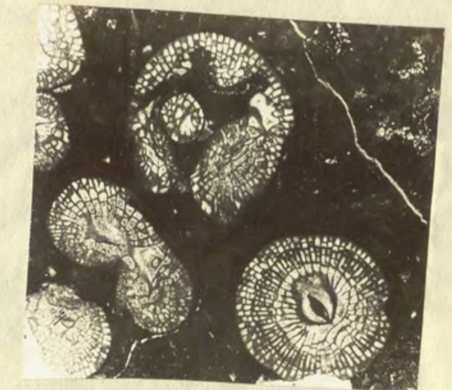
Fig.7:- Transverse section, Bingara, N.S.W., showing stereome. B 2.

Fig.8:- Vertical section ditto.

Fig.9:- Transverse section showing bud and parent with common epitheca, Riverleigh F 24.

PLATE 18


1.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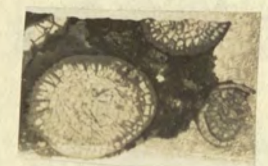
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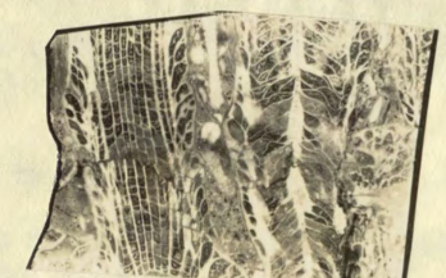
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PLATE 19

Lithostrotion arundineum Etheridge

All figures (except Fig1) x 2 diameters.

Fig.1:- External appearance of paratype (from the Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland). Natural size. Reproduced from Etheridge, 1900, Pl.1, Fig. 3. Specimen in Geological Survey of Queensland Collection.

Fig.2:- Transverse section of topotype; showing septa confluent with columella; and also septa withdrawn from contact with columella. In the University of Queensland collection.

Fig.3:- Vertical section of topotype; showing the arrangement of the tabulae in two series. In the University of Queensland collection.

Fig.4:- Transverse section F 6544 of Australian Museum specimen A.M. 565; from the Horton River between Bulowrie and Pal Lal, N.S.W., showing approach to Cionodendron Benson and Smith in number of septa and size of columella.

Fig.5:- Vertical section F 6544 of ditto; showing typical L. arundineum tabulae.

Fig.6:- Transverse section of typical L. arundineum from near Bulowrie, section F 6546 from spec. A.M. 184 in Australian Museum collection.

Fig.7:- Transverse section of F 2537 (University of Queensland Collection) from Mt. Grim, near Gladstone, Queensland.

Fig.8:- Vertical section of ditto.

Fig.9:- Transverse section of Cionodendron columen Benson and Smith, for comparison with L. arundineum Etheridge. Slide in possession of Dr Stanley Smith, the University of Bristol, from the holotype. (See page 79).

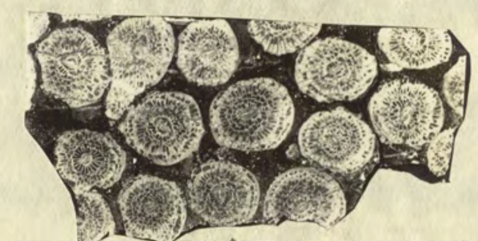
Fig.10;- Vertical section of ditto.

Figs. 8 & 10 are inverted.

PLATE 19


1.


5.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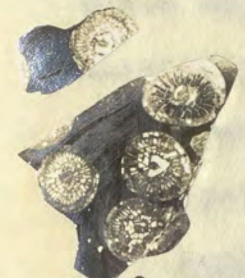
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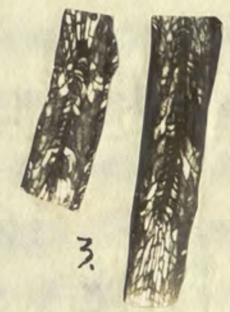
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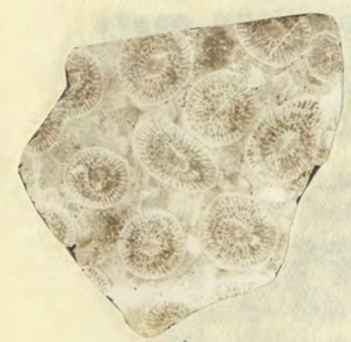
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10.

Lithostrotion genomorph {Diphyphyllum}.

Lithostrotion Fleming, 1830, p.508, genomorph {Diphyphyllum, Lonsdale} Smith and Lang, 1930, p.180.

Genomorphotype: Diphyphyllum concinnum Lonsdale, 1845, p.624, Pl.A, Fig.4. (Since the type of D. concinnum is lost, Smith and Lang, 1930, p.180, base their description of Diphyphyllum on D.lateseptatum McCoy, which if not conspecific is certainly congeneric with D. concinnum).

Diagnosis: "Phaceloid Lithostrotion which have no columella, or one which is reduced to spines on successive tabulae. The axial tabulae may be flat or convex, but have downturned edges which either meet the tabulae below them or extend to the dissepimental wall; the outer, smaller tabulae abut against the inner tabulae. The dissepiments, which are small, are well developed in the larger forms. Gemmation is parricidal."[1]

Remarks: The genomorph[2] occurs in abundance in the Viséan limestones of Europe, usually in association with Lithostrotion. It is possible that it contains representatives of a primitive stage of Lithostrotion, and also forms derived from Lithostrotion by reversion[3].

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(1) Smith and Lang, 1930, p.180.
(2) Smith and Lang (1930, p.180) "restrict the genomorphic name [Diphyphyllum] to the diphymorphs of Lithostrotion, considering that in this group the diphymorph structure is a condition due to other causes than normal phyletic development; and that a suitable stimulus may start any individual along this trend."
(3) Smith and Lang, 1930, p.180.

Lithostrotion sp. {Diphyphyllum sp.}.

(Pl.20, Figs. 1 and 2).

Diphyphyllum sp. Benson and Smith, 1923, p.168.

Material: No. 4510 or 4515, collection of the Geological Survey of New South Wales, and sections R 20872 and R 21998 in the British Museum of Natural History; from the Viséan (Burindi) limestone of the Parish of Moorawarra, near Somerton, New South Wales.

Description: The material consists of a large number of broken and isolated corallites. Each is about 5 mm. in diameter, and straight. There are from 12 to 20 septa of each order. The major septa extend about half way towards the axis, and the minor septa are half this length. The dissepiments are confined to one or two rings, and are small and regular. The tabulae are of two series, the inner ones being large and distally arched, and the outer small and sloping downwards to the dissepiments.

Remarks: This is the only example of {Diphyphyllum} known from Australia. The diameter of its corallites and the number of septa suggest relation to L. arundineum Etheridge. The diphymorph condition is extremely rare in the Australian Lithostrotions; even the slight withdrawal of the septa from the columella is infrequent, whereas it is usual in almost all British Lithostrotions, with the notable exception of the Scottish forms described by Thomson (1883, p.103) which compare with the Australian forms.

<u>Lithostrotion genomorph</u> {Diphystrotion}.

<u>Lithostrotion</u> Fleming, 1828, p.508, genomorph [Diphystrotion Smith and Lang] 1930, p.185.

Genomorphotype: <u>Stylastraea inconferta</u>, Lonsdale, 1845, p.621, Pl.A, Figs. 2, 2a, and e. Smith and Lang 1930, p.185.

<u>Diagnosis</u>: 'Cerioid <u>Lithostrotion</u> in which there is no columella, or one which is reduced to spines on successive tabulae, and in which the tabulae are slightly convex or flat and in most cases complete. The dissepimental tissue is typically coarse. Parricidal gemmation has not been observed.'[1]

<u>Remarks</u>: The cerioid diphymorph is less common than the phaceloid, and the individual corallites always show great variability.

<u>Lithostrotion sp.</u> [Diphystrotion mutabile nov.]

(Pl. 20, Figs. 3-7).

<u>Holotype</u>: F 2387 and 4 slides cut from it, in the Department of Geology, the University of Queensland; from the Upper Visean Limestone of Lion Ck., Stanwell, near Rockhampton. Two

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(1) Smith and Lang, 1930, p.185.

additional slides from the holotype have been placed in the Sedgwick Museum, Cambridge.

Diagnosis: {Diphystrotion} with much thickened corallite walls, and with dissepimental tissue sparsely and sporadically developed.

Description: The corallum is cerioid. The corallites are of sinuous growth, with an average diameter of 4 mm. (See Pl.20, Fig.3). The epitheca of each always has a lining of non-fibrous stereome about 0.05 mm thick. The internal structure varies sporadically in each corallite, and from corallite to corallite. The septa are stout, sinuous, and sometimes separated from the epitheca by dissepiments, on which they may show as crests. There are from 12 to 16 of each order. The major septa are of variable length; the axial edges of 3 to 5 (two being opposite), may very occasionally meet in the centre to form a columella; or the major septa may be only half as long as the radius of the corallite. Intermediate stages between these extremes are more often seen, a frequent feature being the greater length of one, or of two opposite septa. The minor septa are very short with an average length of one third the radius of the corallite. Dissepiments occur sporadically. They are often entirely lacking, but sometimes some of the septa withdraw from the periphery, and a coarse dissepimental tissue results - as in Lonsdaleia. Usually a single ring of coarse cysts is seen between the septa. The tabulae are usually complete and horizontal; but they may be broken or bent up by long axial edges of septa, or by an occasional columella; where no dissepiments are present, the tabulae extend to the epitheca. They are closely spaced, 10 being counted in a space of 5 mm. The columella when present is discontinuous, or is represented by crests of axial septal edges on the tabulae.

Remarks: The type specimen is the only one known. It cannot be the diphymorph of L. columnare Etheridge, the only cerioid Lithostrotion found with it. Variability is extreme; it is sporadic and not at all progressive with growth, this applying even to the development of dissepiments. The diphyphylloid condition is almost complete; and the lonsdaleoid trend is weakly and sporadically expressed.

PLATE 20

Fig. 1:- Lithostrotion sp. {Diphyphyllum sp.}. Transverse section of specimen 4510 (or 4515 ?) in the Geological Survey of New South Wales Collection, from the Visean (Burindi) limestone of the Parish of Moorawarra, near Somerton, New South Wales in the possession of Dr Stanley Smith, the University of Bristol. x 2.

Fig. 2:- Vertical section of ditto, ~~British Museum section-B.~~ x 2.

Fig. 3:- External aspect of holotype of Lithostrotion sp. {Diphystrotion mutabile nov.} from the Upper Visean limestone of Lion Ck, Stanwell, near Rockhampton, Queensland.

Fig. 4:- F 2387 in the University of Queensland Collection. x 4.

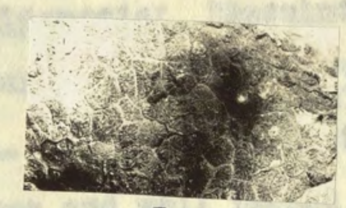
Fig. 5:- Ditto x 2

Fig. 6:- Drawings of some corallites from ditto x

Fig. 7:- Vertical section of ditto. x 2.

PLATE 20

1.



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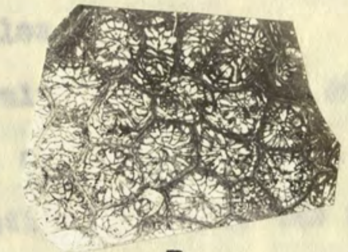

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CIONODENDRON

Cionodendron Benson and Smith 1923 p. 165.

Genotype: Cionodendron columen Benson and Smith 1923, p. 165-167. Pl. VIII, figs. 4 and 5; Pl. IX, figs. 4 and 7, from the Viséan (Burnidi) of N.S. Wales.

Diagnosis: Phaceloid Rugose corals identical in general structure with Lithostrotion Fleming, and comparable in size with L. arundineum Etheridge, but distinguished by the excessively large and well formed columella.

Remarks: See below.

Cionodendron columen Benson and Smith (Pl. 19, figs. 9-10).

Diphyphyllum. 1895, Annual Report Dept. of Mines, N.S.W. p. 188.

Diphyphyllum, Benson. 1921, p. 32.

Cionodendron columen Benson and Smith 1923, p. 165-7. Pl. VIII, figs. 4 and 5; Pl. IX, figs. 4 and 7.

Type material is in the collection of the Geological Survey of New South Wales and consists of the holotype[1] (some sections[2] of which have been placed in the British Museum) from the Viséan Burindi Series of Slaughterhouse Ck, near Gravesend,

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(1) G.S. Reg. 1464.
(2) R. 21999, and R 22000-01.

New South Wales, and an isolated corallite associated with [Diphyphyllum][1] in the Parish of Moorawarra near Somerton, New South Wales.

Diagnosis: As for genus.

Description: Only the type material is known, and this has been adequately described by Benson and Smith (1923, p. 165-7).

Remarks: In growth habit and size of corallites the species closely resembles L. arundineum Etheridge, but is distinguished by the abnormally strong columella, the constancy with which the major septa are confluent with it, the greater number of septa (26 of each order as against 20) and the nature of the tabulae which "for the greater part extend from the theca to the columella, but are bent irregularly and at high angles both towards the theca and towards the columella." Many corallites of L. arundineum from the Horton R., N.S.W., show columellate-septate characters intermediate between L. arundineum and C. columen, but the cionodendroid tabulae cannot be shown to be characteristic of the Horton R. material.

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(1) p. 76, this paper.

ORIONASTRAEA

Orionastraea Smith, 1916, p. 2; 1917, p. 295.

Genotype: Sarcinula Phillipsi McCoy, 1849, p. 125; Smith 1917, p. 295, Pl. xxiii, figs. 1 and 2.

Diagnosis: Astraeoid or sometimes partly cerioid Rugose corals, related to Lithostrotion, but with columella weakly developed or absent; with short septa withdrawn from the axis, and sometimes also from the periphery.

Remarks: The genus is demarcated from the Lithostrotion group in that the development of the diphyphylloid condition is constantly accompanied by the loss of the dividing epitheca and sometimes also by the development of a lonsdaleoid condition. As above defined the genus has probably arisen from different species of Lithostrotion - [Diphystrotion]. In England it is characteristic of and common in the uppermost Viséan. The one Australian species appears to have been derived from the massive Lithostrotion columnare Etheridge by the three changes mentioned above, since the two are found at the same locality and horizon, and these three conditions are seen weakly and sporadically developed in L. columnare.

ORIONASTRAEA LONSDALEOIDES sp. nov. (Plate 21)

Holotype: F. ø and slides in the Department of Geology, the University of Queensland, from the Upper Viséan limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera Queensland. A paratype has been placed in the Sedgwick Museum, Cambridge.

Diagnosis: Orionastraea with the numerous septa of neighbouring corallites separated by a wide development of coarse peripheral dissepiments, with rare traces of epitheca; a degenerate columella is often present.

Description: External characters: The corallum is astraeoid spreading and large. The few calices observed show a central cone rising from a deep narrow collar-like trough ribbed with septa, the trough having a wide broadly domed rim formed by the broadly arched dissepimental tissue between the septa of two neighbouring corallites. The holotheca[1] is thick, with well marked growth rings and longitudinal striations.

Internal structures: The corallites have an average diameter of 10 mm. The septa of each are withdrawn from the periphery and confined to a periaxial column about 5 mm. in diameter. They are rather sinuous and thin, and there are

(1) R.G.S. Hudson, 1929, p. 442, footnote.

from 16 to 18 of each order. The major septa are of unequal lengths; they may all be withdrawn from the axis; but usually one (or sometimes two) is longer than the others, and has a thickened axial edge; often the axial edges of a few others unite with this thickened one, and a degenerate type of columella is thus formed. The minor septa are also of unequal length, about half as long as the major. Since the septa are withdrawn from the periphery, each corallite has a peripheral zone of dissepiments about 2·5 mm. wide, in which the original course of the septa may occasionally be traced by septal crests. These dissepiments are very coarse and broadly arched, and usually continuous with those of neighbouring corallites since only rare traces of a dividing epitheca, in the form of palisade like rods, occur. The dissepiments are arranged domewise over the position of the lost epitheca, and incline so steeply downwards towards the tabulae that they form an almost continuous wall to the septal columns. Small dissepiments are sometimes developed between the major and minor septa. The tabulae are confined to the septal columns. They are closely packed, and usually complete and horizontal, but may be broken and bent up by the axial edges of longer major septa, or by a degenerate columella.

<u>Ontogeny</u>: Buds may arise calicularly (as in phaceloid diphymorphs) but are parricidal only when they are axial in

origin. Non-parricidal buds may also arise, more rarely, from the dissepiments above the position of the lost epitheca; this type of budding is probably a relic of the mural budding characteristic of columellate Lithostrotions.

The initial stage in budding is the formation of a concavity in a small area of the floor tissue, and in this the new structures are laid down, rather thicker than the old. Vertical septal ridges, irregular in course, grow in no set order, and there is very little difference between major and minor septa. Occasionally one seems longer than the others, or possibly two opposite ones join, but there is nothing definitely to prove the presence in the embryo of a columella. But the buds are hysterocorallites, and as such would not be expected to recapitulate in ontogeny the phylogeny of the species. The septa next approach radial regularity, one being longer than the rest, and major and minor septa are distinct and alternate, but without dissepiments between them. Meanwhile external dissepimental tissue is growing up as a coarse encircling tissue. The normal adult expression is attained by the development between the outer parts of the septa of small dissepiments, and a senile stage is reached by the breaking away of these into the peripheral tissue, carrying on them the septal crests.

<u>Remarks</u>: This species, which is known only from the type locality, is undoubtedly a transitional one; for the loss of the epitheca is not entire, and the corallum is not so spreading nor the dissepimental tissue so flat as in typical species of <u>Orionastraea</u>; while the imperfect development of the diphyphylloid condition is seen in the presence of a degenerate columella, and in the occurrence of both parricidal and non-parricidal gemmation. The lonsdaleoid condition is the only one fully developed. In its presumed derivation from <u>L. columnare</u> Etheridge, this species is an interesting example of parallel evolution in different species of the same form group in places as far apart as Queensland and England.

PLATE 21

Orionastraea lonsdaleoides nov. from the Upper Viséan Limestone of Latzas Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections and specimens referred to below are in the University of Queensland Collection.

All figures (except Fig. 1) x 2 diameters.

Fig. 1:- External aspect of paratype F.2529 showing characteristic weathered appearance. Natural size.

Fig. 2:- Transverse section of holotype. F p.

Fig. 3:- Ditto, showing small bud.

Fig. 4:- Vertical section of ditto.

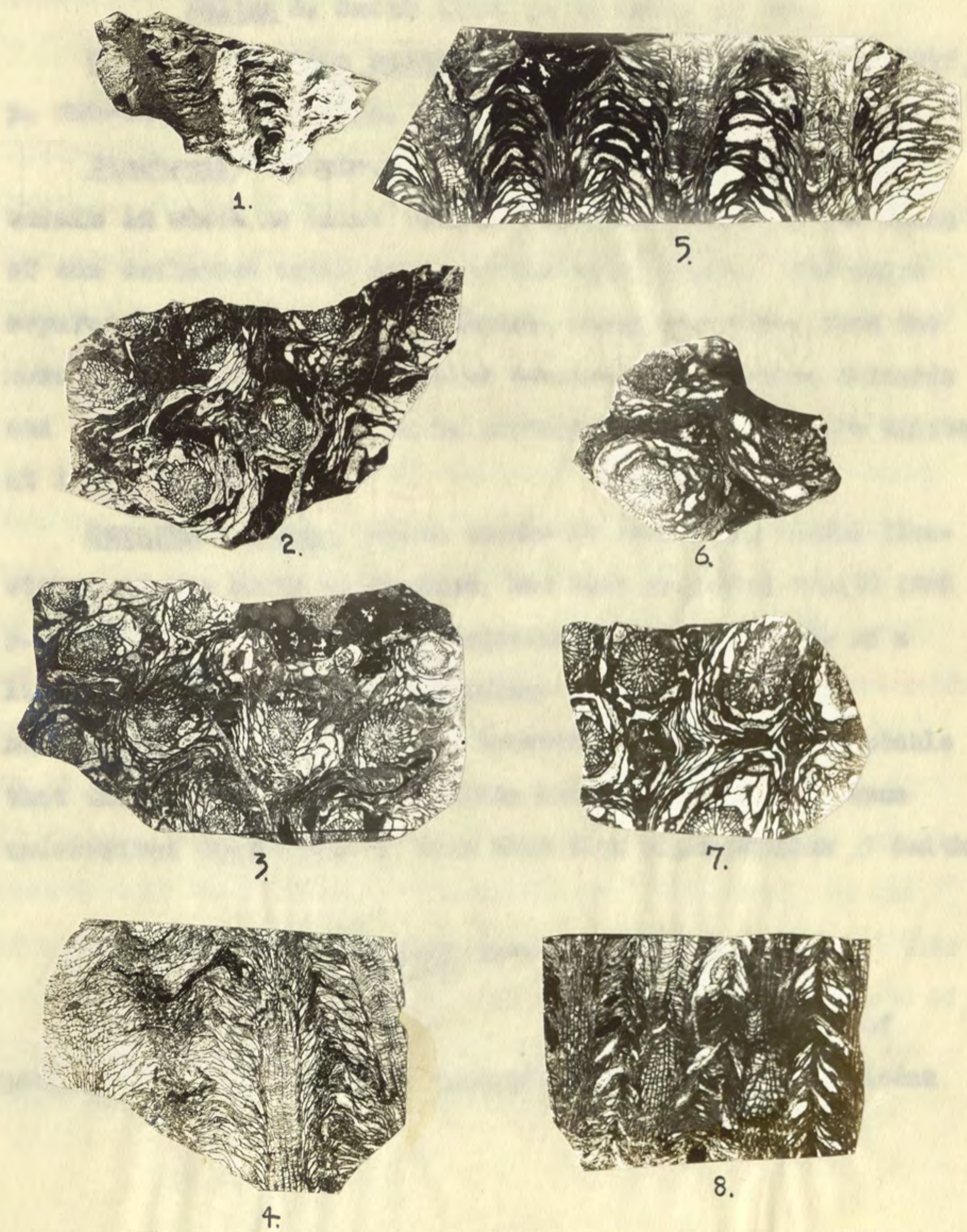
Fig. 5:- Vertical section of F.2533.

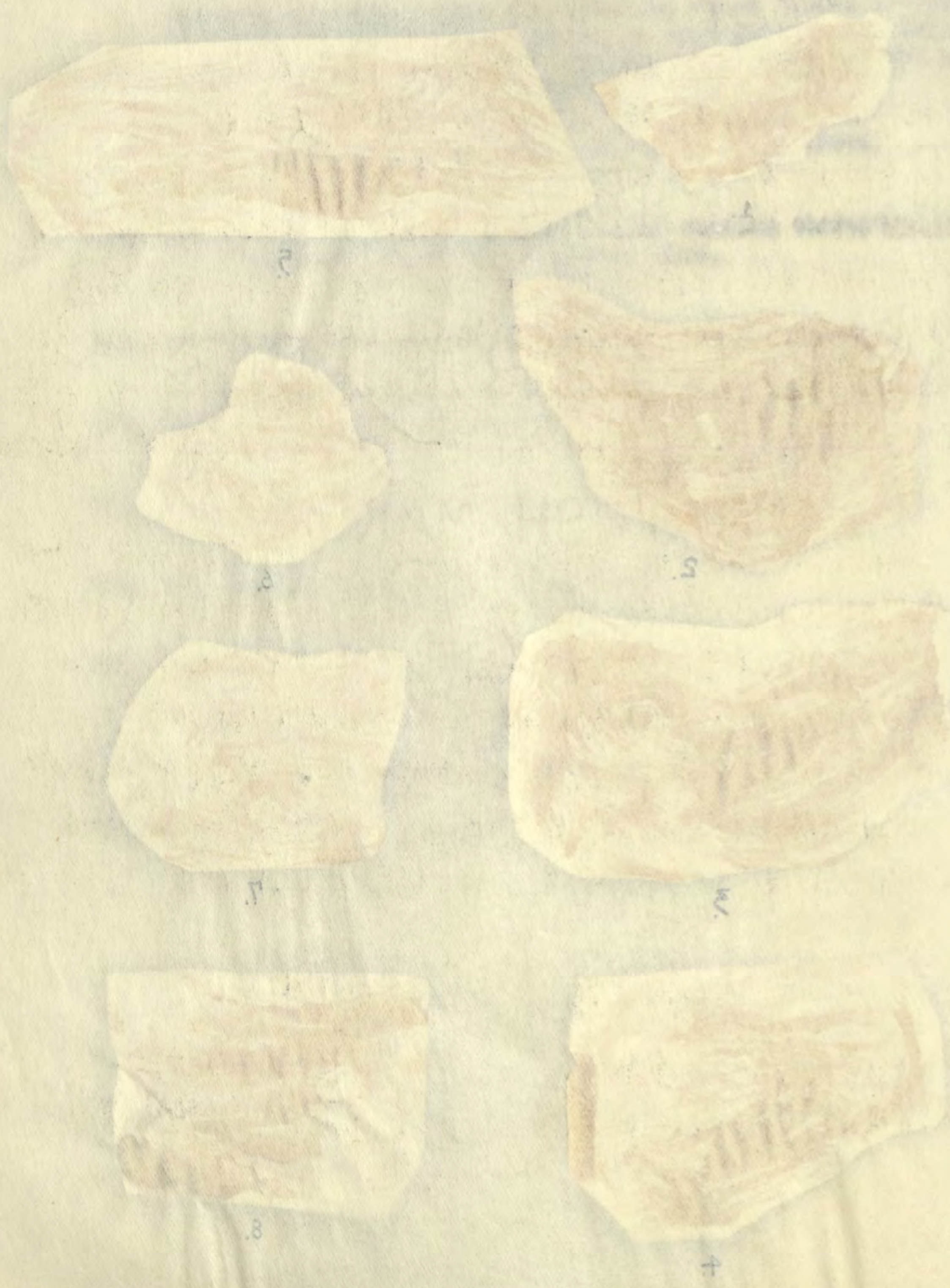
Fig. 6:- Transverse section of ditto.

Fig. 7:- Transverse section of F.2524.

Fig. 8:- Vertical section of ditto.

PLATE 21





AULINA

<u>Aulina</u> S. Smith 1916, p. 2; 1917, p. 290.

<u>Genotype</u>: <u>Aulina rotiformis</u> S. Smith 1916, p. 2-3; 1917, p. 290-4, Pl. xxii, figs. 6-11, and text fig. 4.

<u>Diagnosis</u>: Simple, fasciculate or astraeoid Rugose corals in which an inner tube or aulos is formed by the union of the deflected axial edges of the major septa. The aulos separates the inner larger tabulae, which are flat, from the more numerous outer and smaller tabulae, which slope outwards and downwards. If a theca be present all the septa are dilated at it.

<u>Remarks</u>: <u>Aulina</u>, which occurs in the Upper Viséan limestones of the north of England, has been regarded (Smith 1925 p. 495, and 1928 p. 119) as representing an end point of a lineage from <u>Lithostrotion</u> Fleming. The occurrence in Australia of a simple <u>Aulina</u>, however, makes it more probable that the English compound species have developed from some undescribed simple aulate form than from Diphyphyllum β Smith.

<u>AULINA SIMPLEX</u> sp. nov. (Plate 22).

<u>Holotype</u>: 8 slides (F) in the Department of Geology, the University of Queensland, from the Upper Viséan

limestone of Latza's farm, Portion 22 Parish of Riverleigh, near Mundubhera, Queensland. A paratype (F.2420) has been placed in the Sedgwick Museum, Cambridge.

Diagnosis: Simple Aulina with very sparse dissepiments.

Description: The corals are simple, elongately conico-cylindrical, and of irregular appearance due to short irregularities in the direction of growth, and to growth constrictions and swellings. The average diameter attained is about 5 mm. The epitheca is thick, with indistinct rugae. Root processes are often present.

There are about 20 thin septa of each order, the minor septa being extremely short and tooth like. The major septa are deflected axially and unite to form the aulos or septal tube, the deflection beginning about half way between the epitheca and the tube. The aulos thus formed is wide, about one third the diameter of the corallite. It shows considerable variability. It may be perfectly curved; rarely it may be incomplete and horse-shoe shaped, while in some sections it is absent, and the short amplexoid septa are straight. In this latter case the tabulae are complete and horizontal, of one series only. Usually the tabulae are well differentiated into an inner and an outer series separated by the aulos. Those of the inner series are horizontal, about 4 in a space of 3 mm. Those of the outer series are thinner, and almost twice as numerous, and incline steeply downwards to the epitheca, or dissepiments, if these are present. Dissepiments are only seldom developed, never well enough to form a complete ring; they may cause the septa to be discontinuous with the epitheca.

Ontogeny: Only two specimens were suitable for ontogenetic study. The earliest stage of each examined (diameter 1 mm.) showed a strong epitheca with straight septa meeting at the axis. In one, (corallite A,) the arrangement was pinnate; but in the other (the holotype) it was approximately radial. Only the holotype showed the formation of the aulos (see Pl. 22, fig. 1-17) which appeared at 1·5 mm. diameter as an open loop; the axial ends of 2 septa diverged, and met their similarly directed neighbouring septa, so that an open loop resulted. A root process then caused disturbance in the arrangement, and at a diameter of 2 mm. the aulos was seen to be complete. In corallite A, however, it was already complete at 1·5 mm. diameter, and it cannot be argued on the above evidence that the aulos is first formed as an open loop, since in the holotype the presence of root process may have been responsible for such an origin. The adult stage is attained by the cyclic insertion of very short minor septa, and the sporadic appearance of dissepiments.

Remarks: The aulos is rather less perfectly developed than in the English fasciculate and astraeoid species.

PLATE 22

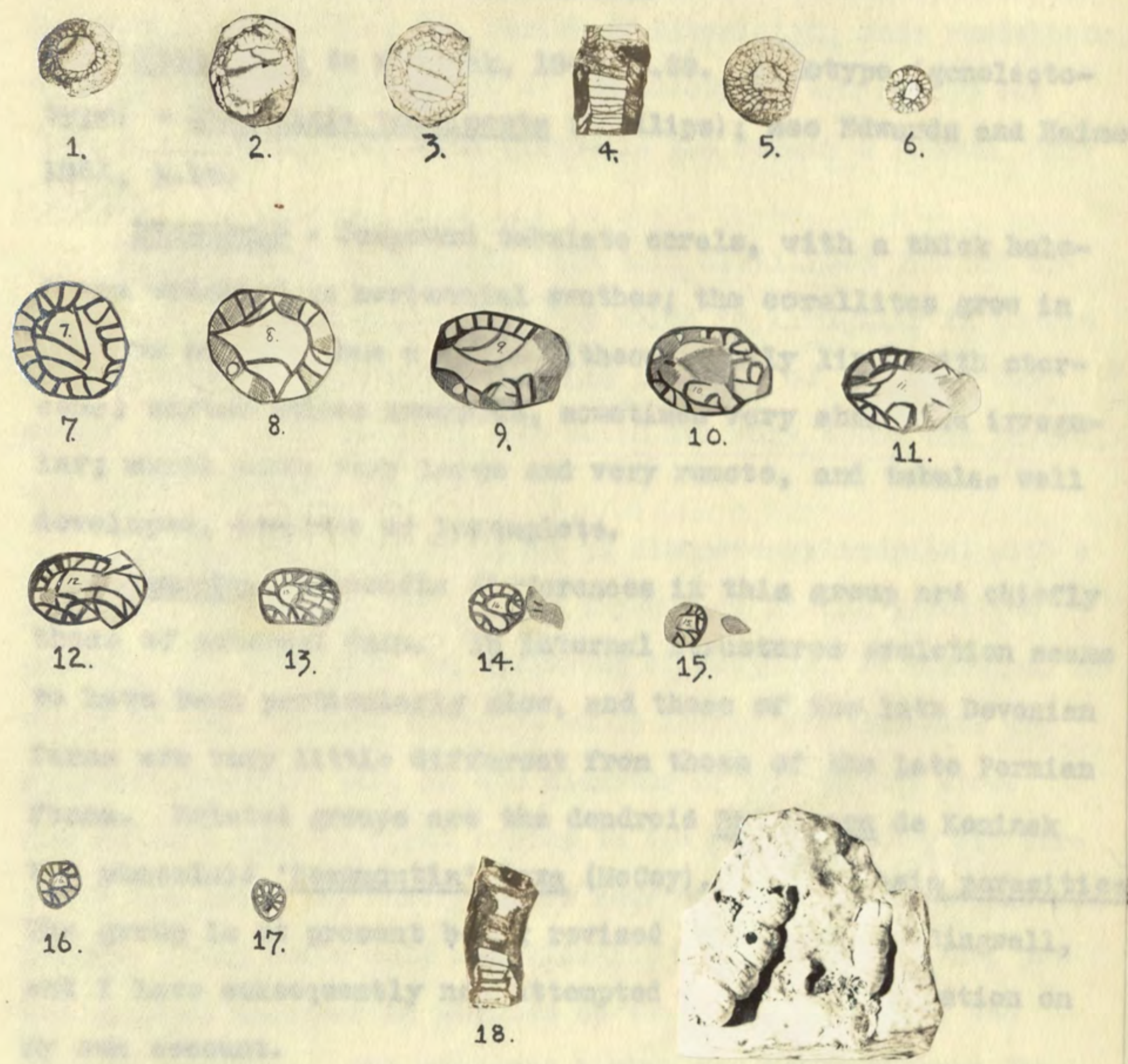
Aulina simplex nov. from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections and specimens referred to below are in the University of Queensland Collection.

Figs. 1-17:- Serial sections of the holotype, B. (Figs. 1-6 x 2, Figs. 7-17 x 4).

Fig. 18:- Vertical section of F 2420. x

Fig. 19:- Paratype. Natural size.

PLATE 22



TABULATA

MICHELINIA

Michelinia de Koninck, 1842, p.29. Genotype (genolectotype) - Michelinia tenuisepta (Phillips); see Edwards and Haime 1851, p.lx.

Diagnosis - Compound tabulate corals, with a thick holotheca wrinkled in horizontal swathes; the corallites grow in bundles and each has a thin epitheca thickly lined with stereome; septal spines numerous, sometimes very short and irregular; mural pores very large and very remote, and tabulae well developed, complete or incomplete.

Remarks. - Specific differences in this group are chiefly those of external form. In internal structures evolution seems to have been particularly slow, and those of the late Devonian forms are very little different from those of the Late Permian forms. Related groups are the dendroid Rhizopora de Koninck the phaceloid 'Beaumontia' laxa (McCoy), and Emmonsia parasitica. The group is at present being revised by Miss J.M.M.Dingwall, and I have consequently not attempted a full investigation on my own account.

MICHELINIA DENDROIDES sp. nov. (Pl. 23, Figs 1-10)

Holotype - F. in the Department of Geology, the University of Queensland, from the Upper Visean limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. A plaster cast of the holotype, and slides cut from a paratype, have been placed in the Sedgwick Museum, Cambridge.

Diagnosis - Michelinia with thin corallites bundled together to form a slender cylinder which is irregular in course and occasionally gives off stunted branches of the same diameter which carry calices; the septa are very short and ragged, and pores are very scarce.

Description - The corallum is elongate-cylindrical with a diameter of about 10 mm, and is inconstant in the direction of growth. It gives off, in different directions, at distances of about 10 mm., stunted branches whose length and diameter are approximately the same as the diameter of the parent stem. The calices open at right angles to the surface; they are circular and deep, and their floors show neither septal striae nor spines. They occur only sporadically on the parent stem, but are grouped together in numbers on the distal parts of the stunted branches. The stereome lining the walls between the calices which open on these branches is very thick; and on weathered surfaces it appears pitted; each calice is immediately surrounded by a raised rim, between two of these rims the stereome is shallowly troughed. The holotheca covering the parent stem and the proximal parts of the stunted branches is coarse, and shows, corresponding to the corallites it covers, series of scallop like wrinkles, continuous laterally with neighbouring series.

The corallites are polygonal in section, and have a diameter of 1·5 to 2 mm; they may attain a length of 8 mm., and are pipe-like and not trumpet shaped as in Pachypora Lindström; they grow parallel with the parent stem and then turn outwards to open at right angles to the surface of the corallum. The buds, which arise intermurally, attain adult diameter very rapidly. The corallite walls have a thick lining of stereome, which increases in thickness towards the calice. The stereome is not channelled as in Palaeacis Haime, nor does it show the lamellae and concentric structure of Pachypora. It is non-fibrous, and like that of Michelinia indica Waagen and Wentzel. Mural pores are very scarce. Septa are developed as short spines; they are irregular and not easily made out, usually merely giving the wall a ragged appearance. Both complete and incomplete tabulae occur, widely spaced, about 0·5 mm. apart, and usually domed.

Remarks: The species is interesting by reason of its scolecoid corallum. There is considerable variation in the length of the corallum, the holotype being the longest found.

MICHELINIA SP. (Pl. 23, fig. 11)

Michelinia sp. Etheridge fil. 1900 p.7. Etheridge's material, one corallum, is in the Geological Survey of Queensland collection from the Upper Visean limestone of Lion Ck., Stanwell, near Rockhampton, Queensland. In the Department of Geology of the University of Queensland there is another rather larger corallum from the same locality and horizon, but it adds nothing except difference in size to Etheridge's description.

Description: The corallum is depressed hemispherical of somewhat irregular growth; one specimen was 25 by 38 mm., another about 50 by 40 mm. The corallites are prismatic and crowded and vary in diameter between 2 and 4 mm. The walls have only a thin investment of stereome. Mural pores are very scarce. The septa are developed as vertical rows of tubercles or short spines, apparently not regularly developed. Tabulae are very numerous, usually as anastomosing tabellae; a few are complete.

Remarks: This species is represented by material insufficient for specific determination, but it evidently belongs to the group of M.tenuisepta (Phillips).

PLATE 23

Michelinia dendroides nov. from the Upper Visean Limestones of Latzsh Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections and specimens referred to below are in the University of Queensland collection.

All figures, (except Fig.1) x 2 diameters.

Fig.1:- Holotype. F natural size.

Fig.2:- View of calices on stunted branch.

Fig.3:- Transverse section of E.52

Fig.4:- Ditto.

Fig.5:- Vertical section of E.g.

Fig.6:- Ditto.

Fig.7:- Transverse section of E.50.

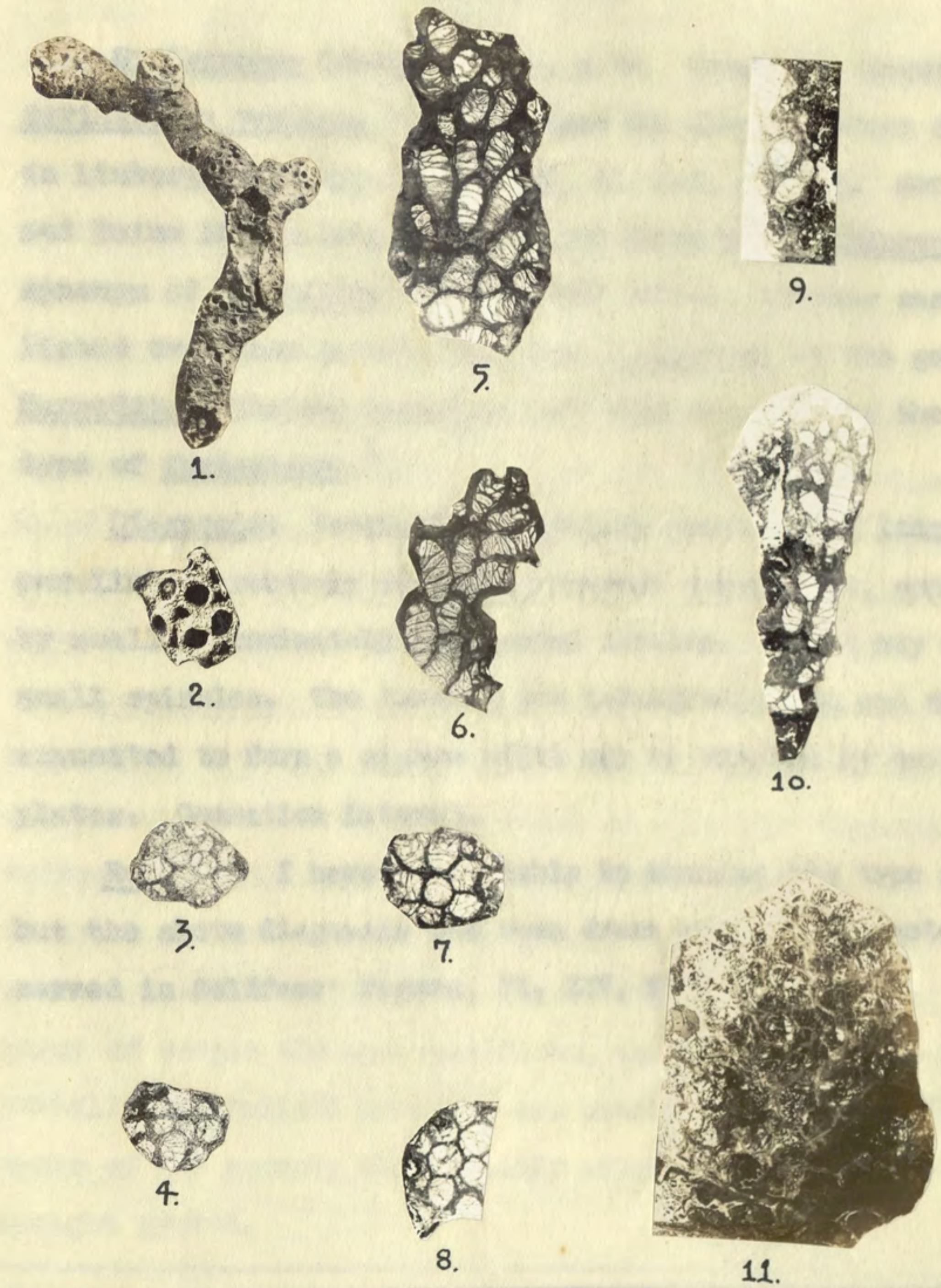
Fig.8:- Ditto.

Fig.9:- Tangential section of E.51.

Fig.10:- Vertical section of E.51. Note septal spines.

Fig.11:- *Michelinia sp* etheridge 1900 p.7 from the Upper Visean limestone of Lime Ck. Stanwell, near Rockhampton, Queensland. F.

PLATE 23



SYRINGOPORA

Syringopora Goldfuss 1826, p.76. Genotype (Genolectotype). Syringopora ramulosa Goldfuss from the Carboniferous of Olne in Limberg, Germany; 1826, p.76, Pl. XXV, fig. 7. See Edwards and Haime 1850 p.lxii [Edwards and Haime give Syringopora as a synonym of Harmodites Fischer 1828 (which, however was published two years later), and take S.ramulosa as the genotype of Harmodites, thereby implying that they consider it the genotype of Syringopora.[1]]

Diagnosis: Fasciculate tabulate corals with long thin parallel to remotely diverging tubular corallites, connected by small approximately horizontal tubules. Septa may occur as small spinules. The tabulae are infundibuliform and centrally connected to form a siphon which may be crossed by horizontal plates. Gemmation lateral.

Remarks: I have been unable to examine the type species, but the above diagnosis has been drawn up from characters observed in Goldfuss' figure, Pl. XXV, fig. 7.

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(1) Lang and Smith MSS.

SYRINGOPORA SYRINX Etheridge (Pl. 24, Figs 1-4)

Syringopora syrinx Etheridge fil. 1900 p.6, Pl. I, figs. 6-9, Pl. II, fig. 11. Type material - is in the collection of the Geological Survey of Queensland from the Upper Viséan limestone of Lion Ck, Stanwick, near Rockhampton, Queensland. Topotypes are in the British Museum, (R 20874-5, R 20878) and in the Sedgwick Museum, Cambridge.

Diagnosis: Syringopora with sub-parallel corallites and extremely rare connecting tubules; the epitheca is heavily lined with stereome which leaves free only the inner third of the corallite; the tabulae are developed in this free space and are more or less horizontal.

Description: The corallum is large and fasciculate. The corallites are long tubes about 2 mm. in diameter, distant, or sometimes coalescent,[1] and parallel or slightly flexuous, and extremely rarely connected by transverse tubules. The epitheca is thick and is ornamented by growth rings and by slight swellings and constrictions. Gemmation is lateral. At the point of origin the new corallites, which issue either horizontally or inclined upwards, are usually about half the diameter of the parent; they rapidly attain adult diameter and an upright growth.

(1) Mural pores have not been observed when two corallites are in contact.

Internal structures: The epitheca is lined internally by a thick deposit of non fibrous stereome, which leaves free only the inner third of the tube. The septa are irregularly developed as vertical series of long spines which are embedded[1] in the stereome lining. The spines are presumably horizontal, but the evidence on this point is not very clear; sometimes their apices project into the free axial space. When perfectly developed, which is rare, the spines form twelve series. The narrow median free space is crossed at unequal wide intervals by unthickened tabulae, which may be horizontal, concave, convex, or irregular. No traces of infundibuliform tabulae have been seen in the stereome. The walls of the buds, and of the rare connecting processes are also lined by stereome. The connecting processes are devoid of tabulate tissue.

Distribution: The species occurs in ~~Upper~~ Viséan limestones at :

(1) Lion Ck, Stanwell, near Rockhampton, Queensland.

(2) Latza's farm, Portion 22 , Parish of Riverleigh, near Mundubbera, Queensland.

(3) Pal Lal , County Murchison, New South Wales.

(4) Crinoid Mt, Diglum, Barmundoo Gold Field, near Gladstone, Queensland.

(5) Station Ck, Mt Morgan, near Rockhampton, Queensland (F. 1700, Queensland Museum Collection).

Remarks: In external appearance S.syrinx resembles S.ramulosa Goldfuss. But the thick lining of stereome and the

(1) The course of the spines through the stereome may sometimes be traced in reflected light.

PLATE 24

Syringopora syrinx Etheridge Palaeacis sp.

Fig.1:- S.syrinx etheridge in his collection of the Geological Survey of Queensland, from two crystalline limestone Crinoid Mt., Diglum, Barmundoo Goldfield, near Gladstone, Q. Natural size, showing external aspect.

Fig.2:- S.syrinx Etheridge. Transverse section of L.   in the University of Queensland collection from the Upper Visean limestone of Lime Ck., Stanwell, near Rockhampton, Q.   x 2

Fig.3:- S.syrinx Etheridge. Vertical section of Ditto.   x 2

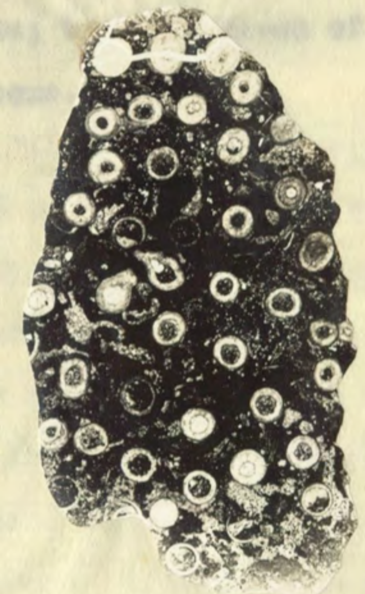
Fig.4:- S.syrinx Etheridge. Vertical sections of F.   in the University of Queensland collection from the Upper Visean limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland   x 2.

Fig.5:- Palaeacis sp.cf.cuneiformis Haime. External View. From the Upper Visean Limestone of Riverleigh, near Mundubbera, Queensland.   x 2.

Fig.6:- Ditto. Abnormally shaped specimen   x 1.

PLATE 24

1.



2.

3.

4.

5.

extreme rarity of connecting tubules make the species very distinctive. It is possible that the inner free space of S.syrinx represents the siphon of typical Syringopora, and that the infundibuliform tabulae are masked by the thick stereome lining, as are the spiniform septa; but no traces of such plates have been observed in the stereome.

Palaeacis

Palaeacis Haime, in H.M.Edwards, 1860, iii; p.171. Genotype (by monotypy) Palaeacis cuneiformis Haime in
H.M.Edwards 1860, iii, p.171, Pl. E.1, fig. 2 (a,b,c,d) from the Lower Carboniferous of Spurgen Hill, (Indiana) U.S.A.

[L.B.Smyth (1929) states (p.125) that "the genus Palaeacis was founded in 1860 by Milne Edwards;" and he also names Milne Edwards (p.133) as the author of the type species, P.cuneiformis. But it is clear from M.Edwards text that Haime was the author of the genus; ("Palaeacis, Haime, note inedite" is given as the original reference). Therefore under Article 21 of the International Rules of Nomenclature[1] it should be referred to as Palaeacis Haime. Milne Edwards' statement, p.171, "Nous donnerons ici la description de ces corps, qui nous a été remise par notre regretté collaborateur, peu de temps avant sa mort", is followed by the heading Palaeacis cuneiformis, and a description; and although there are no quotation marks, it seems clear that Haime was the author of the specific name also in his note inédite.]

Smyth (loc. cit.) gives no diagnosis of the genus, and none is given here, since the minute structure of the type

(1) p.80, Proc. Biol. Soc. Washington. "The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description."

species is unknown, and may not be the same as that described for P.axinoides Smyth, although the ornament and occurrence of pores suggests that it is, and the two species are similar in form. Further it is uncertain whether the species Hydnopora ? cyclostoma Phillips (= Palaeacis cyclostoma (Phill.) Etheridge and Nicholson 1878 p.221 = Microcyathus cyclostoma (Phill.) Hinde 1896 p.447) and P.humilis Hinde, which differ in form from the type species, and in form and structure from P.axinoides are to be included in the genus Palaeacis.

A few imperfect specimens which have been found in Queensland have an identical internal structure with that described by Smyth (loc. cit.) for P.axinoides, and if ~~xxxxxxxxx~~ axinoides is correctly referred to Palaeacis, then the Queensland species is also.

Palaeacis sp. cf. cuneiformis

External form: With one exception the Queensland specimens seem[1] to be keeled and wedge shaped, and very flat, like P.cuneiformis Haime. The exceptional specimen, figured pl. 24 fig. 6, begins like the wedge shaped forms as a pyramid of narrow rectangular cross section, but continues upwards as a flattened prism. The calices are confined to the two narrower sides of the prism, and open directly outwards. The top of the specimen is broken off. In the specimens with the normal semicircular upper margin, the calices are confined to this

(1) They are very imperfect.

upper margin, where they are all in the one median plane, i.e. in the plane of flattening (as in P.cuneiformis), with the possible exception of one calice partly hidden by matrix in the specimen figured Pl. 24, fig. 5. This latter is the largest wedge shaped specimen, and is 20 mm. broad and 6 mm. from surface to surface. The elongate specimen was 10 mm. broad, five mm. from surface to surface, and 25 mm. high.

The apertures of the corallites are oval; in the largest one the longer diameter was 6 mm., and the shorter 3 mm. The calices are funnel shaped, and the sides are marked by longitudinal granular septal ridges; the granules or spines are arranged in transverse rows. The sides are perforated by pores between the septal ridges.

The ornament of the outer surface of the corallum consists of fine, close set ridges, whose disposition is variable. Smyth's description (loc. cit. p.127) of the ornament of P.axinoides applies exactly, and may be repeated. "The ridges may be fairly continuous for some distance. But more often they are broken into short lengths, or even consist of rows of granules. They may be fairly straight and parallel, or sinuous, or may form a labyrinthine pattern, or a chaotic field of granules and short ridges. A parallel arrangement often occurs near the margin of an aperture and at right angles to that margin, and in general is parallel to the axis of a corallite, and indicates its trend within the corallum. When parallel there are from 4 to 6 ridges in 1 mm. Pores occur between the ridges, but can only be seen in tangential section."

In thin section the calcareous tissue of the corallum is seen to be of two kinds, as in P.axinoides: the one forming the lining of the calice, and the other the rest of the corallum. The lining tissue is finely fibrous at right angles to its surface. The tissue of the rest of the corallum consists of closely placed plates each pinnately fibrous, and each arranged at right angles to the surface. The surface ridges of the corallum are the surface traces of these plates and the surface furrows represent the planes of contact of the plates.

A canal system pierces both tissues. The canals open at right angles to the surface into the pores of the calice floor and surface of the corallum, the pores of the lining tissue being larger. The canals become irregular in course shortly below the surface of the corallum, and are concentrated in the tissue between two calices. They are excavated equally from two contiguous plates, and areusually as thick as one plate.

Distribution: Oolitic limestone (probably Upper Viséan) 1½ miles W.N.W. of Mundubbera, Queensland; ~~xx~~ Lion Ck limestone, Stanwell, near Rockhampton; and (reported by Dr Whitehouse, in Reid 1930 p.32 as "Gen. et sp. nov. (a new genus of corals of unknown affinities)" from the top limestone of Portions 37 and 38, parish of Cannindah, 3 miles S.W. of Kalpowar.

Remarks: The structure of the Queensland individuals, their ornament and their granular septal ridges are identical with those of *P.axinoides* as described by Smyth; but they differ from this species by their greater flatness, their oval calicular apertures which are arranged all in one plane, and their funnel shaped calical flores. In their flat shape and the arrangement of their calices and their ornament they resemble *P.cuneiformis*. The structure of the latter species is unknown however, and until it is the specific position of the Queensland specimens will not be clear. The very elongate Queensland individual may or may not belong to the same species as the keeled wedge like ones; further collecting will show. Some specimens of *P.cuneiformis* from the type locality are taller than broad.

THE STRATIGRAPHY OF THE LOWER CARBONIFEROUS (DINANTIAN)
IN AUSTRALIA

In Australia Lower Carboniferous marine (Dinantian) strata have been reported from the east coast Palaeozoic geosynclinal, and from the Kimberley district in Western Australia. They are known only from a series of isolated outcrops, geological mapping being still in an early reconnaissance stage.

In the east these outcrops are included in a strip of country about 60 miles wide which runs south south east inland from St Helens (lat. 21°) to Cannindah (lat. 25°) and south from Cannindah to Babbinboon (lat. 31°) whence it sweeps south south east again towards the coast near Port Stephens (lat. 33°). These marine strata are referred to the Rockhampton series in Queensland and to the Burindi series in New South Wales. The Rockhampton series in its type district is thought to be conformable with marine Upper Devonian (vide infra), but the Burindi series in its type locality is assumed to represent only the Upper Dinantian or Viséan, and succeeds without apparent unconformity a fresh water series with Upper Devonian-Lower Carboniferous plant remains known as the Barraba Mudstones. The Burindi series is succeeded by terrestrial sediments, the Kuttung (? Moscovian) series of volcanic rocks and sediments with a Rhacopteris flora. No rocks which might be referred with certainty to the Kuttung series are known above the Rockhampton series, but near Rockhampton mudstones and grits containing brachiopods of an Upper Dinantian and Lower Moscovian type are found immediately above the limestones which are taken as the top of the Rockhampton series. They are followed (relation uncertain) by the Dinner Ck. series of non marine sediments which contain a *Glossopteris* flora probably of Uralian age.

The Rockhampton series is believed to be conformable with the Upper Devonian of the district since there are 5000-6000 ft of strata (shales, cherts, grits, and pebble conglomerates, calcareous and often tuffaceous) below the Lion Ck limestone (D_2 *vide infra*) striking along the same line as the Upper Devonian; and since the goniatites *Protocanites* and *Pseudarietites*, characteristic of the basal zone of the European Carboniferous are recorded from "Rockhampton District." The top of the Rockhampton series is taken at the base of a pebble conglomerate overlying this D_2 limestone. [Reid and Morton (1928, p.386) postulate a non sequence between the limestone and conglomerate and Reid (1930, p.34) correlates with it certain strata occurring at Cannindah and Mundubbera. This particular pebble conglomerate is however no coarser than others in the Rockhampton series; while the brachiopod fauna of the mudstones and grits above it still has a Viséan character. Reid's correlation of 1700 ft of strata at Cannindah with the postulated non sequence was based on his assumption that a limestone containing *Amygdalophyllum* and *Lithostrotion* below these strata was on exactly the same horizon as the Lion Ck. Limestone. But such an exact

TABLE I. THE LOWER CARBONIFEROUS OF EASTERN AUSTRALIA

Age		Queensland (Rockhampton District)		New South Wales.	
Moscovian		Neerkol Series	Marine strata mudstones with basic Moscovian brachiopods. Pebble conglomerate.	Kutting Series	Terrestrial; lavas & conglomerates with <u>Rhacopteris</u> etc.
Dinantian	Visean		Lion Ck. Limestone (Dr) Coral fauna. Marine strata	Burindi Series	Marine Calcareous shales cherts & tuffs with occasional limestones; with corals & brachiopods.
	Tournaisian		Beds with Protocanites and Pseudarietites. See p.113	Barraba Series	Tournaisian & Upper Devonian Mudstones with <u>Lepidodendron</u> etc.
Devonian			Upper Devonian marine strata.		

TABLE II.

Species examined in this Paper, and their Localities.

X = common or fairly common. Numerals = number of specimens.

	Queensland (Rockhampton Series).							New South Wales (Burindi Series)						
	Latze's Farm, Riverleigh, near Mundubbera.	1½ miles W.N.W. of Mundubbera	Lion Ck., Stanwell, near Rockhampton.	Station Ck., Mt. Morgan.	Mt. Grim, Gladstone Dist.	Crinoid Mt., Diglum, Barmundoo G.F. nr. Gladstone.	Texas	Babbinboon	Parish of Hall, 16 miles south of Bingara.	Quarry at Taree	Horton R., between Eulowrie and Pal Lal	Near Police Station, Horton R.	Moorowarra, Somerton.	Slaughterhouse Ck., near Gravesend.
Symplectophyllum mutatum Hill	X		-											
Amygdalophyllum etheridgei Dun and Benson	-		-					X						
A. inopinatum (Eth. fils).	X		X											
A. conicum Hill.	X		-											
A. sp. near conicum	1		-											
A. vallum Hill	2		-											
Aphrophyllum hallense Smith	-		-						X	X				
A. foliaceum Hill	X		3											
Carcinophyllum patellum Hill	X		-											
Lithostrotion columnare Eth. fils.	X		X								X			
L. stanvellense Eth. fils.	X		X			X			X					
L. arundineum Eth. fils.	-		X		1	X	?				X	X		
(Diphyphyllum) sp.	-		-										X	
(Diphystrotion) mutabile Hill	-		1											
Cionodendron columen Smith	-		-										1	1
Orionastraea lonsdaleoides Hill	X		-											
Aulina simplex Hill	X		-											
Michelinia dendroides Hill	X		-											
M. sp.	-		2											
Syringopora syrinx Eth. fils.	X		X	1		X					X			
Palaeacis sp. cf. cuneiformis Haime	-	X	1											

correlation is shown below to be invalid.]

Non marine and probably Dinantian sediments are known in Queensland from isolated outcrops west and north of the belt of marine Dinantian, in the Drummond Ranges, Star R. Basin, Herberton and Pascoe R. districts; these contain a Lepidodendron and Rhacopteris flora, with in one case (Star R. basin) Phillipsia sp. and brachiopods indicating a marine incursion.

The map appended shows the extent of these Carboniferous rocks, and the localities mentioned.

Age as determined by the Corals.

The corals examined for this thesis and the localities where they were collected are set forth in the accompanying table. They are all Viséan in character.

It is important to know the exact age of the Lion Ck. limestone, since it belongs to the type succession of the Rockhampton series. Etheridge (1900, p.5) who first described its fauna, said the corals had a combined Carboniferous and Permo-Carboniferous facies, but Whitehouse (1928, p.441) gave its horizon[1] as D_2, and this horizon is also suggested by the present work. The Lion Ck. fauna contains no species which can fairly be used to fix its horizon to any zone smaller than the Viséan of the English succession, but more detailed correlation may be made through the larger and more definite fauna from Riverleigh.

(1) In this decision Whitehouse was largely influenced by his determination of a corallite which I have found to be 'Aphrophyllum foliaceum' as Palaeosmilia murchisoni.

At Riverleigh[1] the corals occur in a reef limestone above and below which olive shales occur. Three and a half miles away, nearer to Mundubbera, a coarsely oolitic limestone contains Palaeacis sp. cf. cuneiformis Haime, a species of Evactinopora and two species of lamellibranchs; but owing to faulting, prickly pear and alluvium, its relation to the main and isolated Riverleigh horizon is unknown.[2] The Riverleigh fauna can be correlated with a fair degree of precision with the D_2 fauna of England. The chief evidence for such a correlation is given by Orionastraea lonsdaleoides Hill and Aulina simplex Hill.

In England a species transitional between Lithostrotion and Orionastraea (O. ensifer), appears in the D_2 zone, and is common there. O. lonsdaleoides is undoubtedly such a transitional species, and may therefore be taken as diagnostic of the D_2 zone. The genus Aulina is represented in the north of England by a dendroid and an asteroid species, in limestones believed to be above the D_2 zone of the south of England, and as such referred to a D_3 zone, whose limits and relations are however very inaccurately known. A simple species of a genus must, since there is no known example of a compound form reverting to a simple state, be considered either on the same horizon as, or

(1) This new coral locality was shown to the author by a local resident, Mr F. Mischlewski. The author collected from it, and made reconnaissance surveys first alone, then with a party from the University of Queensland, and later with Dr Whitehouse. The results obtained by these surveys are not sufficiently advanced for publication, but maps with some details are placed in the U. of Q. Geology Dept.

(2) Reid (1930, p.32, footnote) assumes this Palaeacis limestone to be above the Riverleigh horizon.

earlier than, compound species of the same genus. A. simplex thus indicates a high D_2 horizon.

The rest of the Riverleigh fauna gives general confirmation of this result. Symplectophyllum Hill is a clisiophyllid whose variable axial structure is reminiscent of the D clisiophyllids of Scotland and the north of England. Amygdalophyllum is without a representative in England, unless it be the Upper Viséan Konimckophyllum./Aphrophyllum also is not represented in England, but Carcinophyllum patellum is very close to C. densum Ryder from zone D_2./Lithostrotion is known throughout the Viséan, but according to Schindewolf (1928, p.148) very vesicular tabulae such as characterise the Riverleigh species of the genus are diagnosite of the Upper Viséan or D zone. The tabulate corals do not assist in a stratigraphical discussion. The whole fauna is thus undoubtedly Upper Viséan or D in type, while O. lonsdaleoides and A. simplex indicate that it may be more minutely placed as homotaxial with D_2.

Lion Ck. fauna: By reason of its close similarity, the Lion Ck. fauna may also be placed in D_2. It may be slightly earlier than the Riverleigh fauna, but there is not yet sufficient evidence for argument.

Mt Grim., and Diglum: Of these isolated fossiliferous limestones, we can only say that they are Viséan in age, probably Upper Viséan.

Texas: Since the sheared coral from Texas is probably Lithostrotion the possibility that the "Gympie" series of Texas contains Viséan strata must be considered.

Other Queensland localities: In addition to the corals and localities described above, J.H. Reid (1930, p.35) lists from Cannindah in the Upper Burnett, (Portions 37-38, Parish of Cannindah, 3 miles S.W. of Kalpowar) specimens provisionally determined by Whitehouse as

Amygdalophyllum inopinatum (Etheridge)
Cionodendron (?) sp.
Lithostrotian cf. stanvellense Eth. fil.
Syringopora syrinx Eth. fil

Locality wrong. These are from old Cannindah Homestead, S.E. of Monto.

and from a second limestone, estimated by Reid to be approximately 1750 ft above,-

Palaeosmilia aff. retiformis Eth. fil.
Gen. et sp. nov. (a new genus of corals of unknown affinities)[1]

From Cania

Cyathaxonia (?) sp.
Pleurophyllum spp. indet.
Lophophyllum (?) corniculum de kon.

None of these corals have been sectioned, and although I have been unable to obtain them for examinations, I consider that no reliance should be placed on the identifications. Mr Reid

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(1) Palaeacis sp.

(op. cit. p.30) equates the first of these faunas exactly to the fauna of Lion Ck., and therefore advances as an argument for a non sequence above the Lion Ck. limestone, that the 1750 ft of limestones between the two Cannindah fossiliferous horizons are missing at Lion Ck. It is far from certain however that this lower Cannindah horizon is exactly equivalent to the Lion Ck. limestone, for the range of Amygdalopyllum is unknown, while Lithostrotion is common throughout the Viséan.

In New South Wales the isolated coralliferous localities (usually in impure or oolitic limestones) in the Burindi series of shales, cherts and tuffs, all contain very few species, and their stratigraphical relations to one another are unknown. In each case however the coral assemblage is unmistakably Viséan; but one is not justified in arguing further. A few corals which are recorded in W.N. Benson's Census and Index of the Lower Carboniferous of New South Wales (1921, pp.18-24) are not mentioned here, since I have been unable to obtain them for examination. A paratype of Aulophyllum davidis has been cut however, and whatever else it is, it is certainly not Aulophyllum. The specimens seem badly crushed, and the species is probably referable to the group Caninia.

In Western Australia the Geikie and Rough Range series of the Kimberley district are regarded as Viséan in age. David and Süssmilch (1931, Fig. 3, and p.513) list the series as unconformable with the Devonian and Permo-Carboniferous (Uralian), and report the occurrence in it at Price's Ck. of *Lithostrotion* (*Lithodendron*) *affine*, *Syringopora* and *Rhynchonella pleurodon*. On writing for these specimens, however, I was informed that they could not be traced. But the geological survey of Western Australia sent me a specimen labelled *Lonsdaleia aff. floriformis* (Bretnall, Chapman and Glauert, 1906, p.45) from Price's Ck., Rough Range, Kimberley. This has been cut, and is not referable to *Lonsdaleia*. It is probably a diphymorph of a cerioid *Lithostrotion*, but the specimen is too crystalline for accurate determination.

I attempted a comparison of the Upper Viséan (D) coral faunas of England, Russia, China, Japan and Australia, to see what conclusions might be drawn regarding the geographical range, evolution and mutual relations of these corals, and the expression of trends in them. But it was soon obvious that errors in correlation, lack of figures and collection failure made such a comparison foolish in the extreme.

Some points of difference between the English and Australian coral faunas might be commented on, however.

1. The absence of the genera *Lonsdaleia*, *Thysanophyllum* and *Corwenia* in Australia possibly means that these are not related to *Lithostrotion*.

2. The very slight development of the diphyphylloid trend

in the Australian Lithostrotions is in direct contrast to its strong development in English members of the genus.

3. The difference between the Australian and English species of Lithostrotion is one of degrees of development of common trends, not to be accounted for by chronological differences.

4. The absence of Cyathaxonia from Australian facmal list does not necessarily mean that the "Petraia" troup of corals in which minor septal insertion never occurs cyclically is not represented in Australia; for Cyathaxonia is well known as typical of shale facies, and all of the Australian corals dealt with above are from limestone facies.

5. No corals from the English Carboniferous are known to express the "Naos" trend in septal structure. This trend, which is known in Europe from the Middle and Lower Devonian, and in America in the Silurian, is seen well developed in the genus Symplectophyllum, and less well developed in the genera Amygdalophyllum and Aphrophyllum. These facts throw much light on the question of the expression of trends.

Variability in a Coral Species as a resultant of the differential expression of common echo trends.

The descriptions given above of the Lower Carboniferous Corals of Australia may be said to demonstrate the great variability possible in rugose coral species.

That species are variable in a manner quite distinct from and additional to ontogenetic changes, is more easily proved in compounds than in simple species, for differences between individual corallites of a corallum are self-evident and striking. So much so that an investigator working with the inelastic idea of the fixity of characters of a coral species would have no hesitation in placing two such different corallites, which might have been found broken from the corallum, into two different species or even genera. Recent papers by English authors on species of Lonsdaleia (Smith 1916[1]) and Corwenia (Smith and Ryder 1926) in the Carboniferous, and of Stauria (Smith and Ryder 1927), Xylodes and Kodonophyllum (Smith and Tremberth 1929) and Acervularia (Smith and Lang 1931) give excellent demonstrations of this variability of individuals in a corallum.

That variability is equally great in simple species is not so evident, but failure to recognise it has clouded the study of corals with endless lists of synonymous species. In Great Britain the chief unfortunate effect has been the host of species erected by James Thomson[1] for the Scottish Lower Carboniferous corals. That the principle of the fixity of minute characters in a coral species as used by him is wrong, is proved by the fact that later workers have never been able to apply his nomenclature, for no specimens could be found to fit in with all the numerous fixed specific characters required. The chief published papers illustrative of the variation possible within a single species are perhaps those on Aulophyllum fungites (Smith 1913) and Hettonia fallax (Hudson and Anderson 1928). In Aulophyllum fungites it is plain that some expressions are more numerous than others.

Variation in a genus. Smith and Lang (1930) have recently made an important advance in our knowledge of variation in compound coral genera. In dealing with the compound corals Lithostrotion, "Diphyphyllum" and "Stylastraea" they found that the diphyphylloid[2] condition could arise in any member of any species of the genus Lithostrotion, irrespective of horizon, and that it could arise in only a few, most or all of the individuals of a corallum. For such a group of colonies, which is still within the genus, yet differs in a certain character from typical members of the genus, Smith and Lang propose the term genomorph. They recognise species within a

(1) For list of Thomson's papers, see Gregory 1917.
(2) See p. Part I, this thesis.

genomorphic group, each species of the genomorph (Diphyphyllum), for instance being the diphymorph of its parent species of Lithostrotion The trend leading to this diphyphylloid condition in Lithostrotion they regard as an individual trend in contrast to a normal or phyletic trend. Thus it is recognised that amongst the possible variations in a genus, some expressions or conditions will tend to be more numerous or more striking than others, and these are to be regarded as genomorphic groups. Such expressions seem independent of horizon; but there may be some geographical or other physical control. That there is some such physical or geographical control is indicated by the remarkable fact that in Australia the diphyphylloid condition is very rare in Lithostrotion, while in England it is common, throughout the Viséan . Variation in species also seems to have such a control. In most localities the Australian species L. columna is extremely variable; but in one particular locality it has only one expression; i.e. it might be said to have a stable expression here.

To return to variability in a species, then, we have seen that species are variable, and that amongst the various expressions of such a species, some are more common than others. In some cases particular expressions are to be correlated with localities (Lonsdaleia floriformis and vars), and in others with both localities and horizons (A. fungites.

But the Mechanism of Variation is yet to be explained. A study of the Australian Lithostrotion leads to the conclusion that the extreme variability in these three species is due to the different degrees of development of common trends. These have been dealt with fully in the section on the genus Lithostrotion (Ref. p. this thesis). A study of the simple species Amygdalophyllum conicum, A. inopinatum and Aphrophyllum foliaceum leads to the same conclusion. A. conicum gives the most perfect example of variation within a species known to me. In their young stages all individuals show the same characters, but in the adult stage we meet with four distinct groups of individuals; in the first, the adult retains the characters of the young stage. In the second, the septa become separated from the epitheca by coarse dissepiments; in the third, the septa become dilated, and a peripheral stereozone may be developed; in the fourth, such dilated septa may become modified on the Naos plan. These four groups as named, however are only norms amongst the numerous expressions, and although in each group one trend is dominant, the others are also expressed in varying degree, that is, all are potential, or common to every individual. The trends concerned might be referred to as the lonsdaleoid trend, the streptoid trend, and the Naos trend. In addition there may be a slight expression of the diphyphylloid trend.

We have spoken of the expression of common trends as being responsible for variability. And it seems to me that the justification, or perhaps disproof of this assumption would be an advance in our knowledge of the Mechanism of Evolution.

We will enquire, therefore, into the nature of these common trends. Since the word trend has come to mean so many different things to so many different people, it is as well to give my own interpretation[1] of it. This is the original definition of Lang (1923). A trend of development is a line along which a character appears to carry out in its evolution a predetermined course.

The phyletic aspect of a trend of development, and those trends which show it best, have taken pride of place in the literature. One phyletic trend is the progressive change from simple corals through dendroid, phaceloid and cerioid forms to asteroid. It cannot be denied that development along this line is a potentiality to all simple corals, and the trend may be said to be common to all species of corals. A second phyletic trend is the reduction of stereome in *Pycnactis*, leading to *Phaulactis*; a third is the lonsdaleoid trend. But we cannot argue in this place that such trends

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(1) A phenomenon such as the appearance in many different lineages, by many different paths of a columella in the Carboniferous should not be referred to as a trend. It is an acme of homeomorphy.

as these may be common to all species; and we will leave these phyletic or master trends and return to the smaller scale matter of the arising of a diphyphylloid condition in Lithostrotion or, first, the still smaller scale matter of the withdrawal of septa from the periphery in some individuals of A. conicum.

The withdrawal of the septa from the periphery in A. conicum is a sporadic occurrence in the species; it is ephemeral; and can certainly be said to have no phyletic significance. Yet in Spongophylloides grayi the uniform withdrawal of the septa from the periphery in the adult stages is certainly a phyletic change. The parent species of S. grayi had septa reaching right to the epitheca--they do so in the young stage of S. grayi. We can have no doubt that in both cases we are dealing with the same phenomenon; and yet in one species it is important, of phyletic significance; in the other it is a matter for the individual only. In A. conicum the lonsdaleoid trend is only the echo of itself in S. grayi, and yet it is the reason of part of the variability of A. conicum. For such slight manifestation, we may introduce the term echo trend.

This has a similar significance to the 'individual trend' of Smith and Lang; but the individual trend is more strongly and constantly expressed; it is expressed over a whole genus and results in genomorphic groups; but the echo trend merely results in variability in a species.

Now in our classification of trends we have the same trend expressed as a *master trend* or phyletic trend—the lonsdaleoid trend in Lonsdaleia or S. grayi (and others).

as an *individual trend* or genomorphic trend—the lonsdaleoid trend in the genomorphic group (*Lithostrotion*)

(see p. this thesis)

as an *echo trend*—in parts of individuals of the species *A. conicum*, and numerous others.

Our discussion of the *Naos* septal structural trend (pp. this thesis) shows it as a phyletic trend in *Naos* and *Symplectophyllum*, possibly as a genomorphic trend in the Bohemian *Chonophyllum*, and as an echo trend in *Amygdalophyllum* and *Aphrophyllum*.

Now,[1] ~~and~~ then, I believe I am justified in proposing the the 'echoes' of the great phyletic or master trends as responsible for individual variation; and we may return to the question whether all trends are common or potential to *all* coral species.

I think the evidence points rather to the conclusion that they are; but that there must be suitable conditions

(1) ~~Next week, of course, I may not.~~

both within and without the coral before they begin to be expressed. For instance the trend for stereome reduction as from Pycnactis to Phaulactis cannot begin to be expressed if the septa are not already dilated. and Neither can the Naos trend.

BIBLIOGRAPHY to PART I.

Benson, W.N. - 1921. 'A Census and Index of the Lower Carboniferous Burindi Fauna.' Rec. Geol. Surv. N.S.W. Vol.X. Pt. 1, pp. 12-74, pl. viii.

Benson, W.N. and Smith, S. - 1923. 'Rugose Corals from the Burindi Series.' Q.J.G.S. Vol. lxxix (1923) pp.156-71 and pls. viii-ix.

Bretnall, R.W., Chapman, F., and Glauert, L. - 1926. 'Palaeontological Contributions to the Geology of Western Australia, Series VII, Nos. XIII, XIV, XV. Bull. No. 88, Geol. Surv. of W.A.

David, T.W.E. and Sussmilch, C.A., - 1931. 'Upper Palaeozoic Glaciations of Australia.' Bull. Geol. Soc. Am. Vol.42, pp. 481-522; 3 figs.

Dun, W.S. and Benson, W.N.- 1920. 'The Geology and Petrology of the Great Serpentine Belt of New South Wales'. Proc. Linn. Soc. N.S.W. vol. xlv (1920) pp. 337-374.

Edwards, H. Milne.- 1860. 'Histoire Naturelle des Coralliaires' Vol. iii et Atlas.

Edwards, H.M. and Haime, J.- 1850-54. 'A Monograph of the British Fossil Corals' Palaeont. Soc., London.

Etheridge, R. - 1891. 'A Monograph of Carboniferous and Permo-Carboniferous Invertebrata of New South Wales. Part I. Coelenterata. Pal. No. 5, Mem. Geol. Surv.of.N.S.W. pp. 64. Pls. xi.

Etheridge, R. Jn.,-1900. 'Corals from the Coral Limestone of Lion Ck., Stanwell, near Rockhampton. Bull. No. 12, Geological Survey of Queensland. pp. 5-24, 8 pls i and ii.

Etheridge, R. jun. and Nicholson, H.A. - 1878 'On the Genus Palaecis, and the Species occurring in British Carboniferous Rocks.' Annals and Mag. Nat. Hist. Series 5. Vol. 1. pp. 206-227, pl. xii.

Fleming, J.- 1828. 'A History of British Animals.' 8vo. Edinburgh.

Frech, F. - 1885. 'Die Korallenfauna des Oberdevons in Deutschland.' Zeits. derdeut. geol. Gesell. Vol. xxxvii pp. 21-130. pls i-xi.

Gerth, H.- 1921. 'Die Korallenfauna der Dyas von Timor.' Lief.ix. Abt. XVI. pp. 67-147. pls. cxlv-cl, in 'Palaeontologie von Timor'. J. Wanner.

Goldfuss, G.A. - 1826 'Petrefacta Germaniae' Vol. I. pt.l. pp. 1-76, pls. i-xxv. Folio Dusseldorf.

Hinde, G.J.- 1896 'Descriptions of New Fossils from the Carboniferous Limestone, II. ~~On~~ On Palaeacis humilis sp. nov., a new Perforate Coral, with Remarks on the Genus '. Q.J.G.S. Vol. 52, pp. 440-447. Pl. xxiii fig. 1-18.

Hudson, R.G.S., - 1929. 'On the Lower Carboniferous Corals. Orionastraea and its Distribution in the North of England.' Proc. Leeds Phil. Soc., Vol. I, pp. 440-457, Pls i-iv.

1926.- 'International Rules of Zoological Nomenclature'. Proc. Biol. Soc. Washington. Vol. 39, pp.75-104.

Koninck, L.G. de.- 1842. 'Description des Animaux Fossiles qui se trouvent dans le terrain Carbonifère de Belgique.' Liège.

Lang, W.D.- 1923. 'Trends in British Carboniferous Corals' Proc. Geol. Assoc., Vol. xxxiv. pp. 120-136.

—— 1926. 'Naos pagoda (Salter), the type of a New Genus of Silurian Corals.' Q.J.G.S. Vol. lxxxii, pp. 428-35 and pl. xxx.

Lhwyd, Edward.- 1699. 'Lithophylacii Britannici Ichnographia.' etc. 8vo. London and Leipzig. 1760, Editio altera. Oxford.

Lonsdale, W.- 1845. in R.I. Murchison and others, 'The Geology of Russia in Europe and the Ural Mts.,' Vol. i quarto, London and Paris.

McCoy, F.- 1849. 'On Some New Genera and Species of Palaeozoic Corals and Forams'. Annals and Mag. Nat. Hist., Ser. 2, Vol. iii pp.1-20, 119-136.

Ozawa, Y.- 1925. 'Palaeontological and Stratigraphical Studies on the Permo-Carboniferous Limestone of Nagato, Pt.II. Pal. Jour. Coll. Sci. Imp. Univ. of Tokyo. Vol.xlv, pp.1-90 14 pls.

Poeta, F.- 1902. 'Anthozoaires and Alcyonaires' [being tome 2 of Vol. viii in J. Barrandé, 'Systême Siluren du Centre de la Bohême, pt. i: Recherches Paleontologiques'].

Reid, J.H,- 1930. 'The Queensland Upper Palaeozoic Succession.' Queensland Geol. Surv. Pub. No.278.

Reid, J.H. and Morton, C.C.- 1928. Q'l'd. Govt. Mining Journ. pp.386 seq.

Schindewolf, O.H.- 1928. 'Prinzipienpagen der biologischen Systematik. Palaeontologischen Zeitschrift. IX Bd. 1928 p.148.

Smith, S.- 1913. "On the Genus Aulophyllum". Q.J G.S. Vol lxix, pp. 51-77, pls. v.-ix.

——— 1916. 'The Genus Lonsdaleia and Dibunophyllum rugosum'. Q.J.G.S. Vol lxxi for 1915 pp.218-272. pls xvii-xxi.

——— 1916. Abstract Proceedings Geol. Soc., No. 995.

——— 1917. 'Aulina rotiformis, gen. et sp. nov. Phillipsastraea hennati (Lonsdale), and Orionastraea gen. nov.' Q.J.G.S. Vol. lxxii (1916) pp.280-307. Pls. xxiii-xxiv.

——— 1920. 'On Aphrophyllum hallense gen. et sp.nov. and Lithostrotion from the Neighbourhood of Bingara (N.S.W.)' Journ. and Proc. Roy. Soc. N.S.W. Vol. liv (1920) pp.53-63 and pls ii-v.

——— 1925. 'The Genus Aulina'. Annals and Mag. Nat. Hist., Ser. 9, Vol. xvi, pp. 485-496 pl. xxiv.

——— 1928. 'The Carboniferous Coral Nemistium edmondsi gen. et. sp. nov.' Annals and Mag. Nat. Hist., Ser.10, Vol.i, pp.112-120 pl.V.

Smith, S. and Lang, W.D.- 1930. 'Descriptions of the Type-Specimens of some Carboniferous Corals of the Genera "Diphyphyllum" "Stylastraea", Aulophyllum, and Chaetetes. Annals and Mag. Nat. Hist., Ser.10, Vol. V. pp. 178-194. pls. vii-viii.

Smith, S. and Lang, W.D.- 1931.'Silurian Corals .- The Genera Xiphelasma gen. nov., and Acervularia Schweigger, with Special Reference to Tubiporitis tubulatus Schlotheim, and Diplophyllum caespitosum, Hall. Annals Mag. Nat. Hist. Ser. 10, Vol. viii, pp.83-94, pls. ii and iii.

Smith, S. and Ryder, T.A.- 1926. 'The Genus Corwenia gen. nov.' Annals Mag. Nat. Hist. Ser. 9, Vol. xvii., pp. 149-159 Pls. V-VI.

Smith, S. and Ryder, T.A.- 1927. 'On the Structure and Development of Stauria favosa (Linnaeus)'. Annals Mag. Nat. Hist. Ser. 9 Vol. XX., pp. 337-343, Pl.ix.

Smith, S. and Tremberth, R. - 1929. 'On the Silurian Corals Madrepontis articulatus Wahlenberg, - Madrepora truncata, Linnaeus. Annals Mag. Nat. Hist., Ser.10, Vol iii, pp.361-376 Pls. vii and viii.

X Smythe, L.B.- 1929 'On the Structure of Palaeacis' Scient. Proc. Roy. Dublin Soc. Vol. 19 (N.S.) pp. 125-138. Pls, 6, 7,8.

Stuckenberg, A.- 1895 'Korallen und Bryozoen der Steinkohlen-ablagerungen des Ural und des Timan. Mem. Com. Geol., Vol. X, No. 3. with 24 plates.

Thomson, J.- 1880. 'Contributions to our knowledge of the Rugose Corals from the Carboniferous Limestone of Scotland'. Proc. Phil. Soc. Glasgow, Vol xii. pp. 225-261, 3 plates.

——— 1883. 'On the Development and Generic Relation of the corals of the Carboniferous System of Scotland'. Proc. Phil. Soc. Glasgow, vol. xiv, pp. 296-520 pls. i-xiv.

Whitehouse, F.W.- 1928. Q'l'd. Govt. Mining Journal p.441.

Yabe, H. and Hayasaka, Y.- 1915. 'Palaeozoic corals from Japan, Korea, and China, Part III. Lonsdaleia, Lithostrotion, Diphyphyllum, and Thysanophyllum. Journ. Geol. Soc. Tokyo, Vol. xxii. pp 93-109, 127-142.

Hudson, R.G.S. and Anderson, F.W. - 1928 'On the Lower Carboniferous Corals Hettonia fallax gen. et. sp. n. Proc. Leeds Phil. Soc. Vol.1, pp.335-340, Pls. i and ii.

PART II

Type Specimens of the Genera *Carcinophyllum*, *Clisiophyllum*, and *Dibunophyllum*.

CONTENTS

PART II

This section describes the type specimens of the genera Carcinophyllum and Clisiophyllum, and discusses the relationship between Clisiophyllum and Dibunophyllum.

CARCINOPHYLLUM

Carcinophyllum Thomson, 1880, p.241.

Genotype (by monotypy) - Carcinophyllum kirsopianum Thomson 1880 p.243; Text fig. 3, p.241; Pl.II, Figs. 7, 7a and 7b, Lower Carboniferous (upper Visean), Arbigland, Dumfriesshire, Scotland.

Diagnosis:- Simple or dendroid rugose corals, with a central column in which the septal lamellae are dilated, irregular, and anastomosing, and a mesial plate is present. The septa dilate towards the periphery of the corallum, and form a stereozone; but through most of the corallum they are separated from the epitheca by coarse dissepiments. The tabulae between the central column and the dissepiments are widely spaced, and are flat or sagging.

Remarks:- The name Carcinophyllum was introduced by Nicholson and Thomson 1876 pp.70-71, and a diagrammatic figure of the central column typical of the coral they meant was given (p. 71, fig. H). But they mentioned no species, therefore according to Article 25 of the International Rules of Nomenclature (1926, p.81,) the name Carcinophyllum Nich. and Thoms. is a nomen nudum, and the genus Carcinophyllum must be ascribed to Thomson alone, who first published (1880) a description of a species of the genus.

The syntypes of Carcinophyllum Thomson were lost in a fire at the Dick Institute, Kilmarnock. Topotypes are very rare, and none were available to Dr Ryder (1930) when he was examining the English members of the genus. Two topotypes however were found by the present author in the John Smith collection in the Geological Survey's collection at Edinburgh, and one of these[1] is therefore taken as the neotype. Thus the genus Carcinophyllum can now be defined.

Carcinophyllum agrees with the Clisiophyllum-Dibunophyllum group in the possession of a central column, but differs from them in nearly every detail of structure. In the character of the tabulae and dissepiments Carcinophyllum slightly resembles Lonsdaleia.

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(1) The other is too poorly preserved to assist in description.

Carcinophyllum Kirsopianum Pl.1.

Carcinophyllum Kirsopianum Thomson 1880 p.243; Text fig.3, p.241; Pl. II, figs. 7, 7a-7b, lower Carboniferous, Arbigland, Dumfries.

Neotype - (here chosen) - J.S. 255 in the John Smith collection in the Geological Survey Museum, Edinburgh.

Diagnosis - Simple Carcinophyllum with highly anastomosing and strongly dilated tissue in the central column.

Description of the neotype. The corallum is simple conical, 4 cm. high and slightly compressed, but this is partly due to crushing. At the calyx the larger axis is 3 cm., and the shorter 2.2 cm. The epitheca has perished so that the interior of the corallum is exposed. Zones in which the septa extend to the epitheca are seen to alternate with zones where their peripheral edges are separated from the epitheca by coarse dissepiments (See Pl.1, fig.1). The calyx is deep with an irregularly sculptured central boss.

The septa are numerous; just below the calyx there are 46 of each order. They are strongly dilated and the dilation increases towards the periphery so that the minor septa throughout their length are in contact with the major or almost so. A peripheral stereozme whose width is about half the lengths of the major septa is thus formed. Some of the septa are modified in the way shown in Pl.1, fig.4. In a section of 9 mm. diameter

PLATE I

Carcinophyllum Kirsopianum Thomson Lower Carboniferous, Arbigland Dumfries. Neotype; J.S.255; John Smith Collection, Geological Survey Museum, Edinburgh.

All figures x 2 diameters.

Fig.1:- External view.

Fig.2:- Transverse section taken just below calyx. (Upper surface of Fig.3.)

Fig.3:- Median vertical section.

Fig.4:- Transverse section. (Lower surface of Fig.3.) (note septal modification at X.)

Fig.5:- Transverse section taken at base of specimen.

PLATE I

1.

there are 30 major septa, but none of the minor septa were present; yet the major septa were so dilated at the periphery as to form a continuous stereozone. The major and minor septa are usually in contact, so that there is no room for dissepiments between them, but very large dissepiments separate the peripheral edges of the septa from their bases which line the epitheca.

The central column consists of dilated and undilated elements. The former include a bar-like columella, and anastomosing sinuous plates, which are probably modified septal lamellae that have become extremely irregular. The undilated elements are short plates connecting the anastomosing tissue, not particularly horizontal in disposition. The tabulae developed between the dissepiments and the central column are flat or slightly concave, the more complete members are supplemented at their edges by incomplete members.

CLISIOPHYLLUM + DIBUNOPHYLLUM

The generic name Clisiophyllum Dana has been in use since 1846 for corals (chiefly Carboniferous) in which the tabulae are incomplete and inclined upwards towards an axial plate.

Dana (1846, p.187, 1848 p.361; 1849, pl.26, figs.6-7a) however, named no species, and since none can be recognised from his diagrammatic figures and very general description, Clisiophyllum Dana has no status, and the genus Clisiophyllum must be ascribed to McCoy 1849 (p.2) who was the first to describe species under the name. He described in the paper cited three species from the Carboniferous limestone of Derbyshire from specimens in the Sedgwick Museum, Cambridge; and from these three syntypes, according to the Rules of Nomenclature, the lectotype of the genus Clisiophyllum McCoy must be chosen. The syntypes are:-

Clisiophyllum Keyserlingi McCoy p.2.

C. bipartitum McCoy p.2.

C. prolapsum McCoy p.3.

Only the first of these has the structure which more recently has come to be regarded as typical of Clisiophyllum; the second is a typical Dibunophyllum, while the third is the type of the genus Aulophyllum Edwards and Haime.

Description of McCoy's Syntypes

Clisiophyllum Keyserlingi Pl.2.

Clisiophyllum Keyserlingi McCoy 1849 p.2; 1851 p.94, Pl.3e, fig.4, from the Carboniferous Limestone of Derbyshire. Only one specimen was figured by McCoy. It is to be found in the Sedgwick Museum No.A. 2353 and can be taken to be the holotype.

Description of the holotype. The corallum is cornute, 7 cm. high, and attaining a maximum diameter at the calyx of 3 cm. from the deep calyx arises a wide central cone whose sides are ribbed by numerous spirally rotated twisted septal lamellae. The epitheca is mostly destroyed, and is wrinkled transversely. Four transverse sections and one longitudinal have been cut.

The septa are numerous (56 of of each order at a diameter of 3 cms.). The major septa are thin in the dissipimental zone, but dilated axially; they may occasionally be continuous with the thin septal lamellae. The minor septa are very short, about one fourth the length of the major, and not dilated. The dissepimental zone is narrow, corresponding with the length of the minor septa, and the dissepiments are fine, regular, and very steeply inclined. The axial structure has a diameter one third that of the corallite. The septal lamellae are thin and about half as numerous as the major septa, they abut on to a short bar-like central plate, which is usually thickened. They are straight in the lower half of the corallite, but are rotated in the upper part. The concentric arrangement of the tabellae gives the axial structure a spider web pattern. The tabulae are incomplete and the tabellae are of two series; the inner series, that of the axial structure, is of very numerous plates sloping rather steeply up to the nuclear bar of the axial structure; the outer series, between the axial structure of the dissepiments, consists of fewer plates sloping less steeply upward; there is no dividing wall between the two series.

PLATE 2

From Camera Lucida Drawings by R.G.Carruthers.

Group I. Clisiophyllum Keyserlingi McCoy

Sections from the type specimen, A. 2353 in the Sedgwick Museum,

Cambridge: Carboniferous limestone (Upper Visean) Derbyshire.

All figures natural size, except the diagram, Fig.2.

Fig.1:- Side view of type ('Palaeozoic Fossils' Pl.3e, 1 4)

Fig.3:- Diagram showing segments cut from above.

Fig.3,3a,3b,3c, Transverse sections cut from segments I,III,IV, & V respectively.

Fig.3d:- Median vertical section from segment II.

Group II. Dibunophyllum bipartitum (McCoy 1849) (= Clisiophyllum turbinatum McCoy. 1851)

All figures natural size, except the diagram, Fig.2.

Fig.1:- The type specimen of D.turbinatum A.2393 Sedgwick Museum, Cambridge. ('Palaeozoic Fossils', p.88,fig.a) Carboniferous limestone, Upper Visean, Derbyshire.

Fig.2:- Diagram showing segments cut from above.

Fig.3-3a. Lower & Upper surfaces of segment V.

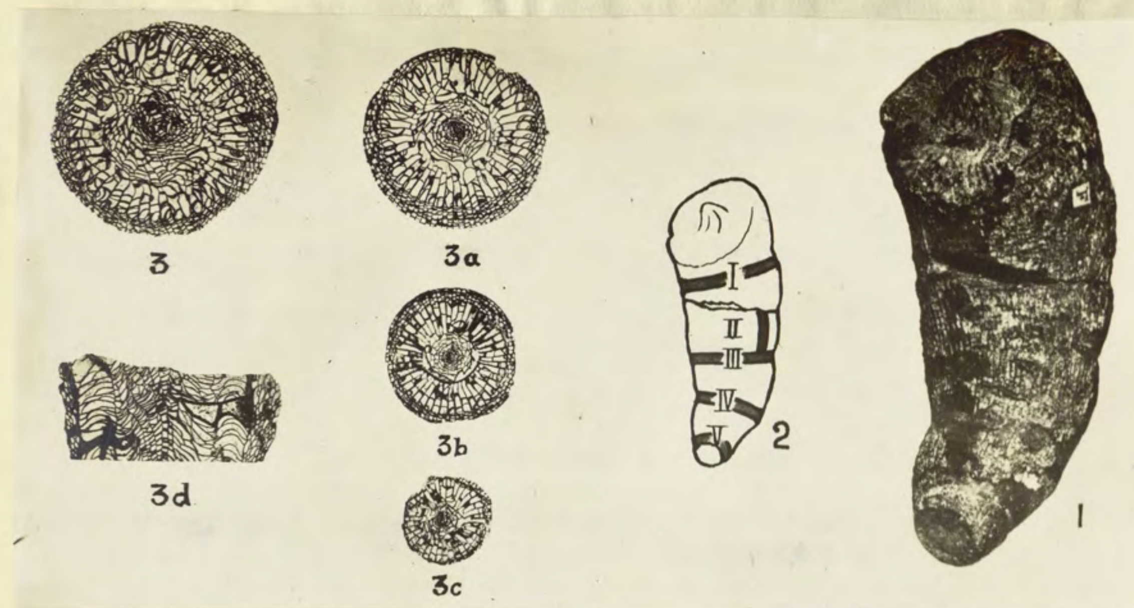
Fig.4:- Lower surface of segment IV.

Figs.5,5a & 6,6a. Lower & Upper surfaces of segments III & II respectively.

Fig.7:- Lower surface of segment I.

Fig.8:- Median Vertical section of a topotype of D.turbinatum

PLATE 2



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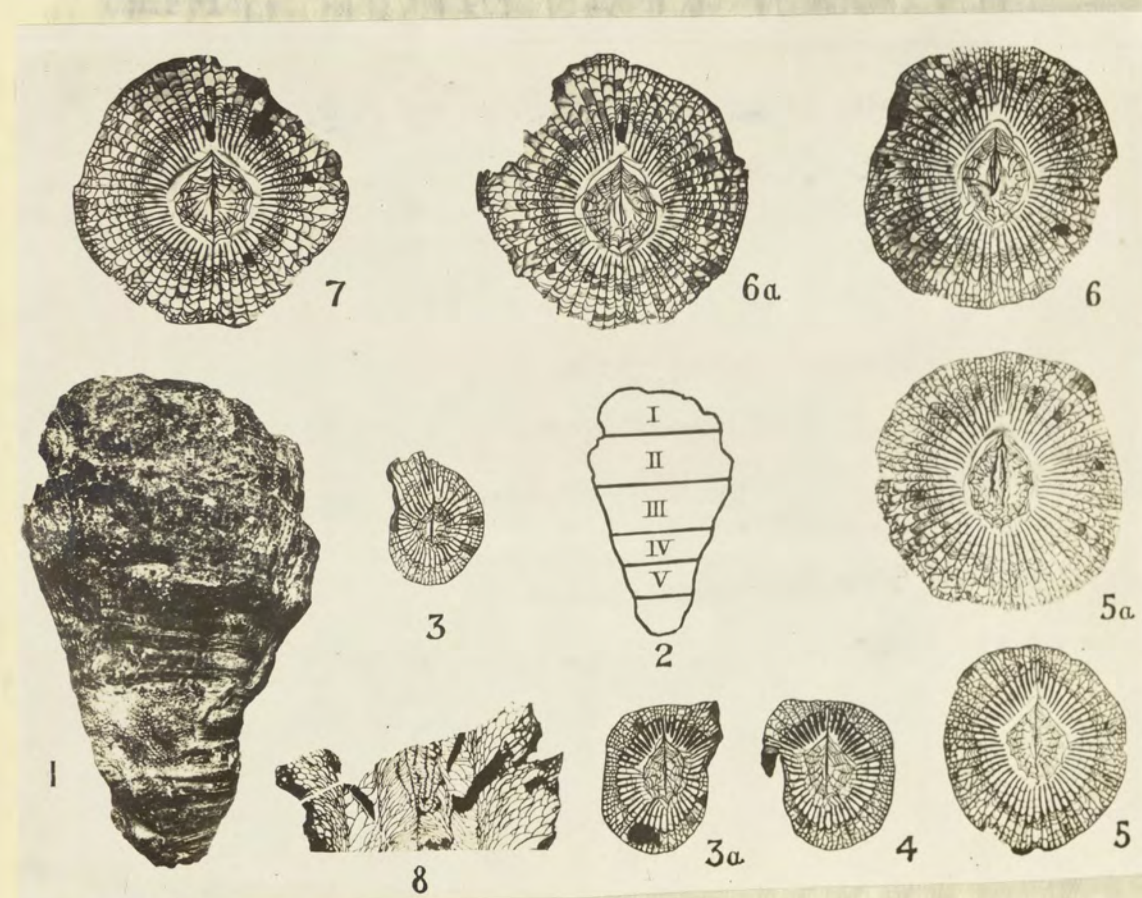

2.

not capital CLISIOPHYLLUM BIPARTITUM Pl. 3

Clisiophyllum bipartitum McCoy 1849, p. 2; 1851, p.93, Pl. 3c, figs. 6, 6a, Carboniferous Limestone, Derbyshire. [In the 1851 paper, McCoy adds the locality Beith, Ayrshire, Scotland, to the type Derbyshire locality; which alone was mentioned in 1849. But the three Beith specimens have proved to be Aulophyllum fungites.]

Description of syntype figured McCoy 1851, Pl. 3C, fig. 6. The corallite (A. 2366 in the Sedgwick Museum, Cambridge, is a fragile, weathered, robustly cornute corallite about 8 cm. high and 3 cm. in diameter[1]. Most of the smooth epitheca and a great deal of the dissepimental tissue has been weathered away. The very deep calyx shows an oval domed central boss which is about 1 cm. in diameter. Along its greater axis the boss has a median crest lower at one end. On one side of the boss eight lamellae extend from its periphery towards the median crest, but do not meet it. On the other side, lamellae cannot be distinguished.

The specimen was strengthened by boiling in balsam, and then cut transversely in two places. It proved to be mostly hollow, but one surface from near the calyx showed the internal structure fairly well. A camera lucida drawing

(1) The unweathered corallum would be 4 cm. in diameter.

of it has been made by Mr A.G. Brighton (Pl. 3 fig. 5). This surface shows 57 strong major septa, and no minor septa. Those parts of the septa at the inner rings of dissepiments are well preserved; but the peripheral edges are broken away, and in most of the corallite the axial edges also are destroyed. None of the axial edges are continuous with the septal lamellae. The dissepiments are crowded, and usually complete across the inter-septal loculi; but often they are incomplete, two meeting at an angle near the middle of the loculus.

The oval axial structure, whose shorter radius is approximately equal to the distance between it and the inner rings of dissepiments, is well defined by sections of tabulae. A median plate marks the larger axis of the structure, and fringing sections of very small tabellae are seen along one side of it. About eight septal lamellae extend on each side from the edge of the axial structure towards the central part of this median plate, but do not reach it. A few sections of tabulae may be seen between the lamellae but they are concentrated at the periphery of the axial structure.

Remarks - A vertical section could not be obtained; but it is sufficiently obvious from this transverse surface that the specimen has a typical dibunophylloid structure.

PLATE 3

Dibunophyllum bipartitum (McCoy).

All figures x 2 diameters

Fig.1:- Transverse section of the lectotype (A.1971 Sedgwick Museum, Cambridge.)

Fig.2:- Vertical section of the lectotype.

Fig.3:- Calicular view of syntype figd. McCoy 1851 Pl. 30 fig.6.

Fig.4:- Transverse section of syntype figd. McCoy 1851 Pl. 30 fig.6a. showing the less typical 'Histrophylloid' section of the axial structure.

PLATE 3

<u>Description of syntype figured McCoy 1851, p. 93,</u> <u>Pl. 3C, fig. 6a</u>. This specimen, A. 2367 in the Sedgwick Museum, consists of two small fragments which when placed together give about 2 cm. of a bisected corallite. Three transverse surfaces and one longitudinal have been polished, and these were evidently used by McCoy for his drawings of the internal structure of <u>C. bipartitum</u>.

There are 27 major septa in the half corallite, and these are all dilated axially, the dilation beginning at the inner ring of dissepiments. On one side of the half corallite these axial edges are curved aside; some of them are continuous with the thin septal lamellae of the axial structure, which occupies about a quarter of the corallite. In the dissepimental zone the septa are thin and irregular in course. Very short minor septa may be seen right at the periphery, but are more often absent. Dissepiments are copiously developed over a zone half as wide as the length of the major septa. The inner ring is invested with stereome. The dissepiments may stretch right across an interseptal loculus, but are more often incomplete, two meeting at an angle near the middle. The axial structure varies in pattern in the three transverse surfaces. On the top surface, at one end, the septal lamellae are straight in course, and discrete from the axial edges of the septa and directed towards one stronger axial lamella, as in typical Dibunophyllum. At the other end of the axial structure the few thin septal lamellae may be continuous with septa, and are twisted as in "Rhodophyllum." Sections of tabulae are seen between the lamellae, but the axial structure is not cut off from the rest of the corallite by such sections. On the other two transverse surfaces all the septal lamellae (seven in the half corallite) are twisted without much uniformity.

The vertical surface shows that the incomplete tabulae are arranged in an inner and an outer series, the outer containing fewer and less steeply inclined plates than the inner which are domed in the axial structure. All the plates are convex upwards and outwards.

Remarks - At first sight the difference in axial structure would seem to indicate a specific difference from the lectotype; but it can be shown in other Derbyshire material that the two types of axial structure can occur in the same individual, and that neither is necessarily the adult stage of the other.

Unfigured syntypes - These are A. 1971, A.1972, A.1973 in the Sedgwick Museum collections.

A. 1971 and A. 1972 are fragments of robust individuals with exactly the same type of transverse sections as that of the figured specimen. A. 2365. Since the structure is well seen in both these specimens, and is that most typical of the species, one of them (A. 1971) is chosen as <u>lectotype</u> of the species in preference to either of the figured syntypes which are both very poor specimens. We are thus able to figure slides cut from the lectotype. The vertical section shows the same structure as that described for figured syntype A. 2367.

A. 1973 is part of a robust individual whose axial structure has one of the less typical expressions of the species; the few septal lamellae are irregularly twisted, and the mesial plate is not conspicuous. Its septal, dissepimental and tabulate characters are the same as in the other syntypes.

<u>Clisiophyllum prolapsum</u>.

<u>Clisiophyllum prolapsum</u> McCoy 1849, p.3; 1881, p.95, Pl.3c, figs. 5,5a = <u>Turbinolia</u> <u>Fungites</u> Fleming 1828, p.510. = <u>Fungites</u> Ure, 1793, p. 327, pl. XX., fig. 6, is the genotype of <u>Aulophyllum</u> Edwards and Haime 1850, p.lxx. See Smith and Lang 1930, p. 187.

space.

McCoy did not name any of these species as typical of the genus, and it was therefore left to later authors to chose a lectotype.

In 1850 om their Introduction to the British Fossil Corals (p.lxx) Edwards and Haime referred to <u>C. danaianum</u> Edwards and Haime from the Lower Helderberg (Upper Silurian) of Perry Co, Tennessee, U.S.A, as "Typ. sp." of the genus Clisiophyllum dana, and described it in 1851 in their 'Monographie des Polypiers Fossiles des Terrains Palaeozoic (p.412). This selection is invalid, since McCoy's three species were the first described with the generic name. In the Introduction to this Monograph (1881) however, they name (p.170) as "Example" of the genus Clisiophyllum. C. Keyserlingi McCoy. It is unfortunate that the use of the French terms 'Example' (although Edwards and Haime obviously meant it as synonymous with the "Typ sp" of their English work) cannot be accepted as choosing a type according to the Rules of Nomenclature, for C. Keyserlingi is obviously the only suitable lectotype. Other authors, between 1851 and 1931, have named typical species, but none were chosen from McCoy's syntypes, and their selections are also invalid.

In November 1931, an abstract, signed by M. Macgregor, of a paper on "The Genus Clisiophyllum" by Macnair and Leitch read before the Geological Society of Glasgow, appeared in that Society's Proceedings (p. 612), containing the following passage: "He," (i.e. Macnair) "described the type species C.Bipartitum McCoy. Clisiophyllid corals have been divided into many genera and species by authors, especially Thomson, and it was the purpose of the present communication to show that these can be reduced to four types of variation from a standard form -

C.bipartitum being selected as having priority according to the rules of nomenclature."

If this is to stand as a valid selection of a lectotype, the choice is exceedingly unfortunate, for the structure of C.bipartitum is that typical of the group known as Dibunophyllum which has given the zonal name to the Upper Viséan.

(1) However, I have read through the typescript of Macnair and Leitch's paper, and nowhere can I find any statement concerning the type species of the genus Clisiophyllum. If these authors chose C. bipartitum as type, then they did so verbally at the reading of the paper, and I question whether a verbal statement recorded in an abstract can be allowed as a choosing of a type. Furthermore, Macnair and Leitch's idea of a typical species of Clisiophyllum, as is obvious from their typescript, is a species with the structure of C.keyserlingi; species with the structure of C.bipartitum they refer to as dibunophyllid.

In case it should be argued that Macgregor fixed the type of Clisiophyllum, I would point out that he does not on his own or Macnair's authority state that C.bipartitum is the type: he merely, under a misapprehension, refers to the species that Macnair had in mind as C.bipartitum, which he (Macgregor) supposed was the type; but which, as an examination of Macnair's typescript shows, had the structure of the C.keyserlingi group.

(2) If however, the statement, that C.bipartitum McCoy is the lectotype of Clisiophyllum, as made in the anomalous circumstances described above, be ruled a valid selection of a lectotype, and it be considered desirable to have separate generic names to denote corals with clisiophyllid and dibunophyllid structure, it could be argued that C.bipartitum McCoy is already the genotype of the genus Dibunophyllum Nich. and Thoms. For Gregory (1917) selected D.muirheadi Nich. and Thoms as lectotype of Dibunophyllum, and D.muirheadi can be shown to be a synonym of C.bipartitum; and since C. bipartitum was already the type species of Dibunophyllum, then Macnair and Leitch's "selection" of it as gentype of Clisiophyllum is invalid. We are then left with C.keyserlingi as the only one of McCoy's three syntypes which is not the type of another genus, and consequently it must be used as the genotype of Clisiophyllum.

If however it be argued that since Clisiophyllum McCoy is an earlier genus than Dibunophyllum Nich. and Thoms; and, because the same species is the type of both, then Dibunophyllum is a synonym of Clisiophyllum, and if this be the final reading; then, the dibunophyllid and clisiophyllid corals can still be referred to under separate generic names by proving the former to be genomorphs of the latter. This relation is undoubtedly a correct one; but much more detailed investigation than the present would be required to satisfy the general reader. For the present, however, I consider that Clisiophyllum and Dibunophyllum may conveniently be regarded as separate genera, with genotypes C.keyserlingi and C.bipartitum respectively, on the strength of arguments (1) and (2), particularly (1), and Edwards and Haime's evident intention with regard to 'Example' in their French work. This is everywhere synonymous with "Typ. sp." in their English monograph, and if the latter be regarded as valid selection of a type, then it is anomalous that the former should not be so construed. The following generic diagnosis may then be given.

Clisiophyllum. Pl.2. Group 1.

Clisiophyllum McCoy 1849. p.2.

Genotype (genolectotype, here chosen) - Clisiophyllum keyserlingi McCoy 1849, p.2; 1851 p.94, Pl.3c, fig.4. from the Carb. Lime of Derbyshire.

Diagnosis - Large simple cornute corals with a wide axial structure whose septal lamellae are about half as numerous as the major septa, are often twisted vertically, and abut on to a short thickened central plate. Minor septa very short, and dissepiments regular and few, in a zone as wide as the length of the minor septa. Tabulae incomplete, tabellae of two series, the plates of the outer being fewer and less steeply inclined upwards than those of the inner.

Clisiophyllum keyserlingi

Clisiophyllum keyserlingi McCoy 1849, p.2; 1851 p.94, Pl.3c, fig. 4. Carboniferous Limestone (Upper Viséan) Derbyshire.

Diagnosis - Clisiophyllum with septal lamellae straight in the lower half of the corallite, and uniformly rotated in the upper half; septa 56 of each order at a diameter of 3 cm.

Description - As given above p. 7.

Remarks - This specific diagnosis may not be elastic enough, for only one specimen, the holotype, has been studied.

Dibunophyllum Pls.2, Group 2, ,and Pl.3.

Dibunophyllum, Thomson and Nicholson 1875-76 p. 48, Nicholson and Thomson 1877. p. 127.

Genotype - Dibunophyllum muirheadi,Thomson and Nicholson 1875-6, pl. xxiv, figs, 3,3a, Pl.xxv, Figs. 4,4a, 5 (?), Nicholson and Thomson, 1877 p. 129, Pl.ii figs. 2 and 3. from the Carboniferous Limestone of Gateshead, Beith, Ayrshire, Scotland; = Clisiophyllum turbinatum McCoy 1851, p.95; p.88, figs. a.b.c, from the Carboniferous Limestone of Derbyshire;

= Clisiophyllum bipartitum McCoy 1849, p 2; 1851, p. 93, Pl.3c. figs. 6, and 6a,from the Carboniferous Limestone of Derbyshire.

Diagnosis - Robust simple cornute rugose corals with a wide variable axial structure consisting typically of a median axial lamella, a few (usually four to eight) septal lamellae on either side directed towards the central part of the axial lamella, and numerous tabellae, sloping steeply down at its periphery; less typically the bilateral radiate arrangement is lost; the axial lamella is not dominant, and the lamellae may be twisted. Minor septa usually absent; dissepimental zone wide, dissepiments both complete and inosculating. Tabulae of two series, the inner being the crowded Tabellae of the axial structure, and the outer consisting of fewer and less steeply inclined plates.

Remarks - The genus is probably more corrected regarded as a genomorph of Clisiophyllum McCoy; all variations between the two norms can be found, sometimes in the same individual. The less typical forms in which the bilaterally radiate axial structure is lost are also probably genomorphic.

Dibunophyllum bipartitum Pl.2, Group 2, Pl,3.

Clisiophyllum bipartitum McCoy 1849 p.2, 1851, p.93, Pl. 3c, figs. 6, 6a. lectotype, here chosen, A.1971 Sedgwick Museum, being one of McCoy's unfigured syntypes from the Carboniferous limestone of Derbyshire.

Synonyms -

Clisiophyllum turbinatum McCoy 1851 p.95; p.88, figs.a,b,c, from the Cabboniferous Limestone of Derbyshire (Holotype A.2393. Sedgwick Museum).

<u>Dibunophyllum muirheadi</u>[1] Thomson and Nicholson 1875-76 Pl. xxiv, figs. 3,3a, Pl. xxv, figs. 4,4a, 5l?) Nicholson and Thomson 1877 p. 129, pl.ii, figs, 2,3, from the L.Carboniferous of Gateside, Beith, Ayrshire, Scotland.

<u>D.McChesnyi</u>[1], Thomson and Nicholson 1875-76, pl.xxv, figs. 3,3a,3b, Nicholson and Thomson, 1877 p.130 pl.ii, fig.4, from the Lower Carboniferous of Brockling, near Lesmehagow, Lanarkshire.

<u>D. splandens</u>[1] Nicholson and Thomson. 1877, p.131, pl.ii, figs.1 [in Thomson and Nicholson 1875-6, Pl. xxv, Fig.1 = This pl.ii, fig, 1; in their earlier paper it is called D.sp. from Langside, Beith Ayrshire, and in the later, D. splendens from Gateside, Beith, Ayrshire.]

<u>D. matlockense</u> Sibley, 1908, p.74, Pl.1. fig. 2, D_2 subzone near Wensley, Derbyshire. (Holotype: part in B.M. and part A.2360, Sedgwick Museum).

<u>D. derbiense</u> Sibley, 1908, p.75, Pl.1, fig. 1. D subzone, Monsal Dale, Derbyshire. (Holotype: in B.M.)

<u>Diagnosis</u> - as for genus.

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(1) It will be necessary before publication to select neotypes for these species.

Description - The corals are robust, curved in the early stages and usually approaching a cylindrical shape in the adult. The calyx is deep, and shows a domed oval boss, usually symmetrical about a median crest, towards the central part of which a few lamellae are directed. The epitheca is smooth and wrinkled transversely; it often shows a longitudinal ridge external to the cardinal fossula.

The major septa are numerous and usually dilated. The whole septum may be dilated, but most often only those parts axial to the inner ring of dissepiments are affected, and dilation may be confined to the cardinal quadrants. A cardinal fossula is present due to the shortness of one or more major septa; less striking alar fossulae may also be present. Minor septa are weakly developed, very short and irregular in course. Dissepiments are copiously developed, and smaller and more steeply inclined in the inner rings, so that in section they seem to be concentrated there. The innermost ring may be invested with stereome. Due to the absence of minor septa, the dissepiments are often not complete across the interseptal loculi; two may meet at angle towards the middle of the loculus.

The axial structure is usually oval, and its smaller diameter is about one quarter that of the corallite. Typically it consists of a median lamella, towards the central part of which from four to eight straight or rather sinuous septal lamellae are directed from either side; and inclined tabellae, arranged in domes whose apex is at the centre of the median lamella; the angle of inclimation of the tabellae usually increases very sharply at the periphery. The median lamella may extend completely across the axis, or, while reaching the periphery at the cardinal end, may fall short at the counter end. In some sections it may be produced into the cardinal fossula, and attached to any one of the fossulae septa. It may be fringed by very small sections of tabellae; or it may be missing from among these small sections. (This gives the vesicular central lamella of "_Albertia_"Thomson).

Less typically this bilaterally radiate pattern is seen at one end of the structure only, and at the other the lamellae (including the median lamella) are rotated as in _Histiophyllum_ Thomson. Or the whole of the lamellae may be rotated, regularly or sinuously, giving a rhodophylloid pattern. The septal lamellae are never dilated. Between the tabellae of the axial structure and the dissepiments an outer series of tabellae are developed, which, while still convex upward and outward, are much less steeply inclined than the axial tabellae, and more sparsely distributed.

<u>Remarks</u> - Variability in the axial structure is great. Sections showing the lamellae rotated and without distinct median lamellae may occur in the same coralite as sections showing the typical bilaterally radiate structure, without regard to growth stages. But while the lamellae are inconstant in arrangement, they remain fairly constant in number (four to eight on each side); and this constancy, the nature of the minor septa and of the dissepiments, are diagnostic characters. Should the lamellae increase in number to about half as many as the major septa, then a clisiophylloid axial structure would result. But the modified minor septa and dissepiments of <u>Dibunophyllum</u> suggest that this group is derived from the clisiophllids, and not vice versa.

It is regarded as most probable that further work will show that the species or genomorph <u>Dibunophyllum bipartitum</u> should include all those forms from the British Upper Viséan placed by various authors in the genera <u>Dibunophyllum</u>, <u>Aspidiophydum</u>, <u>Histiophydum</u>, <u>Rhodophyllum</u>, <u>Cymatiophyllum</u>, <u>Centrophyllum</u>, and <u>Albertia</u>.

BIBLIOGRAPHY to PART II.

Dana, J.D.- 1846. 'Genera of Fossil Corals of the Family Cyathophyllidae'. Am. Jour. Sci. and Arts (Silliman's Journal) 2nd Ser., Vol. I. pp. 178-189.

—— 1846-9. 'United States Exploring Edition during the years 1838,1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N.- Zoophytes by James D. Dana, A.N. Geologist of the Expedition, with a Folio atlas of 61 plates. pp.x+ 740. Philadelphia. pp.1-120 and 709-720 previously appeared folio Philadelphia, 1846 (Feb.) The complete work appeared in March 1848. Atlas in Nov. 1849. pp.352-364 appeared earlier in pp.179-189 of A.J.S. and Art, 2nd Ser., Vol I, 1846.

Edwards, H.M. and Haime, J.- 1850-54. 'A Monograph of the British Fossil Corals' Palaeontol. Soc., London.

Edwards, H.M. and Haime, J.- 1851. 'Monographie des Polypiers Fossiles des Terrains Palaeozoiques'. Arch. Mus. Hist. Nat. Vol. V. pp. 1-502.

Fleming, J.- 1828. 'A History of British Animals'. 8vo.Edinburgh.

Graham, A.W. and Skiner, W.H.- 1909. 'North American Index Fossils. Invertebrates, Vol.i, viii., 853 pp.

Gregory, J.W.- 1917. 'Thomson's Genera of Scottish Carboniferous Corals'. Transactions Geol. Soc. Glasgow. Vol. XVI, Part II pp. 221-243.

1926.- 'International Rules of Zoological Nomenclature' Proc. Biol. Soc. Washington, Vol. 39, pp. 75-104.

Lambe, L.M.- 1901. 'The Madreporaria Aporosa and the Madreporaria Rugosa. Contrib. Carb.Pal., Vol. iv., pt.ii. Rev. Cam. Pal., 1901, pp. 97-197, i, ii, pls vi-xviii.

Lindstrom, G.- 1883 'Index to the Generic Names applied to the Corals of the Palaeozoic Formations. Bib. K. Svenk. Vet. Akad. Hand., Vol. viii., No. ix., 14 pp.

Macnair, P.B. and Leitch C.M.- 1931. Abstract of'the genus Clisiophyllum' signed by M. Macgregor, in Proc. Geol. Soc. Glasgow, Vol. p.612.

McCoy, F.- 1849. 'On Some New Genera and Species of Palaeozoic Corals and Foraminifera'. Ann. Mag. Nat. Hist. Ser. 2, Vol. iii, pp.1 - 20, 119-36.

——— 1850. 'On some New Genera and Species of Silurian Radiata in the collection of the University of Cambridge.' Ann. Mag. Nat. Hist. Ser. 2, Vol. vi, pp. 270-90.

——— 1851-54. 'British Palaeozoic Fossils', in A. Sedgwick, 'British Palaeozoic Rocks'.

Miller, S.A. - 1889. 'North American Geology and Palaontology for the Use of Amateurs, Students, and Scientists 793 pp.

Ryder, T.A. - 1930 'Notes on Carcino phyllum' Nich. and Thom., with Descriptions of two new Species'. Annals Mag. Nat. Hist. Ser. 10, Vol. v. p. 337-351.

Salée, A. - 1913 'Contribution à l'Etude des Polypiers du Calcaire Carbonifère de la Belgique. II. Le Groupe des Clisiophyllides. Mem. Inst. Geol. Univ. Louvain, Vol. 1., pp. 177-293, pls iv-xi.

Sherzer, W.H. - 1891 'A Chart of the Rugose Corals. Amer. Geol. Vol. vii., pp. 271-301.

Sibly, T.F.- 1908. 'The Faunal Succession in the Carboniferous Limestone (Upper Avonian) of the Midland area (North Derbyshire and North Staffordshire). Q.J.G.S. Vol. 64, pp. 34-82, Pl. 1.

Smith, S. and Lang, W.D., - 1930. 'Descriptions of the Type specimens of some Carboniferous Corals of the genera 'Diphyphyllum', 'Stylastraea' Aulophyllum and Chaetetes' Annals Mag. Nat. Hist., Ser. 10, Vol. V., pp. 178-194, pls. vii-viii.

Thomson, J. and Nicholson, H.A.- 1876. Contributions to the study of the Chief Generic Types of the Palaeozoic Corals. Ann. Mag. Nat. Hist. (4) Vol. xviii pp. 65-73 pls i-iii.

Thomson, J. - 1880 'Contributions to our knowledge of the Rugose Corals from the Carboniferous limestone of Scotland.' Proc. Phil. Soc. Glasgow, vol xii, pt. i, pp. 225-261, iii pls.

Ure, D. - 1793. 'The History of Rutherglen and East Kilbride'. 8vo. Glasgow.

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PART III

A PRELIMINARY REVIEW OF
THE STRUCTURE OF THE SEPTA OF RUGOSE CORALS.

PART III

A PRELIMINARY REVIEW OF THE STRUCTURE OF THE SEPTA OF RUGOSE CORALS.[1]

In searching through coral literature for parallels to the remarkable modified septa seen in the Australian Rugose coral genus <u>Symplectophyllum</u>, I was much struck by the observations

(1) that there were many different kinds of septal modification,

and (2) that in some way the septa of each genus differed from the septa of most other genera. It seemed to me therefore that a closer examination of the structure of rugose coral septa might lead to some broad principles of importance to systematics and evolutional theory; and this preliminary survey was therefore begun.

It was soon obvious that this study could not be carried through without parallel studies on the deposition of secondary tissue, i.e. stereome, (since septal modifications seem always resultant on previous dilation of the septa), and on the variability of species (since even in one transverse section the septa vary). The variability of species has been dealt with in Part I of this thesis (pp.118-125).

The skeleton of a Rugose coral consists of fibrous calcareous tissue which by analogy with the living Hexacorals may may be accepted as having been secreted behind the polyp as it

1 This essay is still in 'first draft' form.

grew upward. Such tissue, in addition to the epitheca is of two kinds. The first is fundamentally horizontal in inclination, and is laid down as floors by the basal part of the ascending polyp; the second is fundamentally vertical, being formed in invaginations in the basal parts of the polyp, into which it therefore projects. The chief vertical elements are the septa, which are secreted by radially arranged invaginations; and it is with these that this paper is chiefly concerned, although a study of the horizontal and other vertical elements is to a certain extent complementary.

I accept Miss Ogilvie's finding that the septum consists of trabeculae, each of which is composed of a series of fibrous groups, each group being deposited round a distinct axis of calcification.

That there is great diversity in the structure of the Rugose coral septum has been insufficiently recognised. Miss Ogilvie (1896) has shown that there is great diversity in the structure of the Hexacoral septum; but I cannot find any mention in her study of any variation in septal structure within the one genus species or individual. If I understand correctly, she accepts septal structure as constant in the members of a species. But my studies on the Rugose septa have shown that such variation is the rule rather than the exception; and no systematic conclusions derived from septal structure should be made without recognition of this fact and its implications.

My studies have also led to the working hypothesis that there are two sorts of secondary tissue or stereome, one being mainly characteristic of corals with spinose septa, and the other of corals with lamellar septa. The first is apparently laid down by the whole of the base of the retreating polyp over those skeletal parts already formed (spines and all) and its fibres are parallel to the retreating base. The second is laid down only on the sides of that part of the septum already formed at the top of an invagination, and its fibres are continuous with those of this original part of the septum. Thus in both cases "stereome" is the concrete noun for the abstract "secondary thickening". I do not yet understand why secondary thickening is more pronounced is some individuals or parts of individuals than in others.

Spines never occur without this all-covering stereome. When in spinose corals the stereome instead of being laid down with its fibres parallel to the floor, is laid down with its fibres in continuity with those of the spines, then lamellar septa result. This is a very important observation, but its full significance is not yet obvious. It would seem to indicate that the spinose septum is primitive, and the lamellar septum derived; but such a relation may be more apparent than real. A corollary of the greatest importance is whether the spines of the spinose septa are homologous with the trabeculae of the lamellar septa; my investigations indicate that they are, but I have not satisfactorily proved the point. A very interesting

Text Fig A.

Radial Section of Hexacoral Septum.

a-b = area of divergence at the theca.

c = growth line.

d = trabecula.

fact is that with one exception (Calostylis) the spines of spinose septa and the trabeculae of lamellar septa are always arranged normal to the surface of the floor tissue.

It is also worthy of note that there is no area of divergence of the trabeculae in the lamellar rugose septum, except in Acervularia where there is an inner wall. The area of divergence of the trabeculae in the Hexacoral is always at the position of the theca (See Text Fig. A). Its absence in Rugose corals other than at the inner wall of Acervularia (and even this, vide infra, is not a strictly homologous case) probably indicates that there is no true theca in Rugose corals. A meeting of the trabeculae in the Rugose coral septum is seen at the junction of the dissepiments and tabulae (See Text Fig. 26); for in the tabular area the septal trabeculae are arranged at right angles to the tabulae; but in the dissepimental area they are arranged at right angles to the dissepiments. But this is a convergence, and not a divergence.

Whether any given type of septal structure is primary or secondary in origin, or a degeneration, is obviously of the greatest importance; but one cannot easily come to a decision on this question in any given case. It is also necessary to know whether any structure is characteristic of any one line of descent, or is potential in any coral; and whether it appears at only one horizon or recurs. I cannot yet answer these questions with conviction.

Streptelasma corniculum

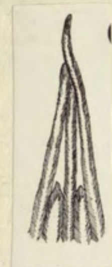


Fig. 1.
T.S.

Fig. 2.
Tg. S.

Fig. 3
V. S.

Notes on the Various Types
of Septal Structure in Rugose Coral Genera.

ORDOVICIAN

Streptoid septa are seen in Streptelasma corniculum Hall from the Cincinnatian of Waynesville, Ohio and S. sp. from the Jordan Stage, G.I., Kallasto, Insel Dago. Two specimens (Sedg. Mus. Coll.) of each of these species were sectioned, and the septal characters were similar. Both major and minor septa are so thick in the lower half of the corallite that they are almost perfectly in contact with one another; but with upward growth the zone of contact retreats further and further peripherally, leaving the septa axially only half as thick. In transverse (T.S.) and Tangential (Tg.S.) section the septum usually has a narrow median area which in transmitted light appears darker than the rest of the septum, and by reflected light more densely white. On either side is a wide lighter area in which a fine fibrous structure is usually apparent. The fibres are pinnately arranged and meet at the median dark line where their points are directed towards the epitheca in T.S., (See Fig. 1), and proximally in Tg.S. (See Fig. 2). In some parts of these Corals, as seen in Tg.S. at the periphery, the median dark line has a zig-zag course.

Miss Ogilvie has shown that this 'median dark line' represents nothing more than the position of the centres of calcification of the septum. In the case of Streptelasma these centres are arranged along the median plane, and the fibres on each surface are all directed in the same direction. In Radial vertical section (V.S.)(See Fig.3) the fibres of the septum are all arranged approximately at right angles to the epitheca.

Pinnately fibrous dilated lamellar septa in which the swelling becomes confined to the periphery in the upper part of the corallite may be referred to as streptoid.

I have not observed stereome deposits on the tabulae of the Streptelasma .

SILURIAN

Streptoid septa

These are seen in the following Valentian species, described by S. Smith (1930)[2]:- [Orthophyllum] sp. and [Paterophyllum] sp., three species of Streptelasma, and Onychophyllum pringlei. The arrangement of the septa one to another differs in these species, but their structure is similar. In the Wenlock and Ludlow various species of Streptelasma are known, with streptoid septa.

Pycnactoid septa.

These are seen throughout the Silurian. My slides of 2 specimens of Pycnactis mitrata from the Visby Marls of Gotland show contiguous dilated septa, pinnately fibrous at a wide angle, the points of the fibres meeting at the median plane of the septum, and being directed towards the periphery (in T.S.). In Tg.S., the fibres are only slightly inclined upward and outward from the median plane. In the <u>Pycnactis-Phaulactis</u> lineage (Ryder 1926) the septa are reduced from the periphery progressively inwards, leaving in the zone of reduction thin leaf-like septa whose structure has not been resolved by the microscope. In some <u>Phaulactids</u> the axial dilating stereome cannot be seen to be fibrous, and appears as investing layers on either side of the septum.

<u>Spinose Septa</u>

are septa which are represented by spines arranged in vertical series. At first sight they would seem fundamentally different from the lamellar pinnately fibrous septa of the Ordovician and Silurian; yet in <u>Palaeocyclus porpita</u> and <u>Tryplasma loveni</u> both types occur.

<u>Cantrillia frisca</u> from the Valentian shows vertical rows of spines on the wall; but if each row represents one septum, then in this species, which is only 6-7 mm. in diameter, there are about 60 septa ! The spines can be seen in the calyx, but in the body of the corallite they are buried over their points in a lining of stereome. This is clearly built up of successive layers of stereome, and shows no structure apart from the buried

Acanthocyclus sp.

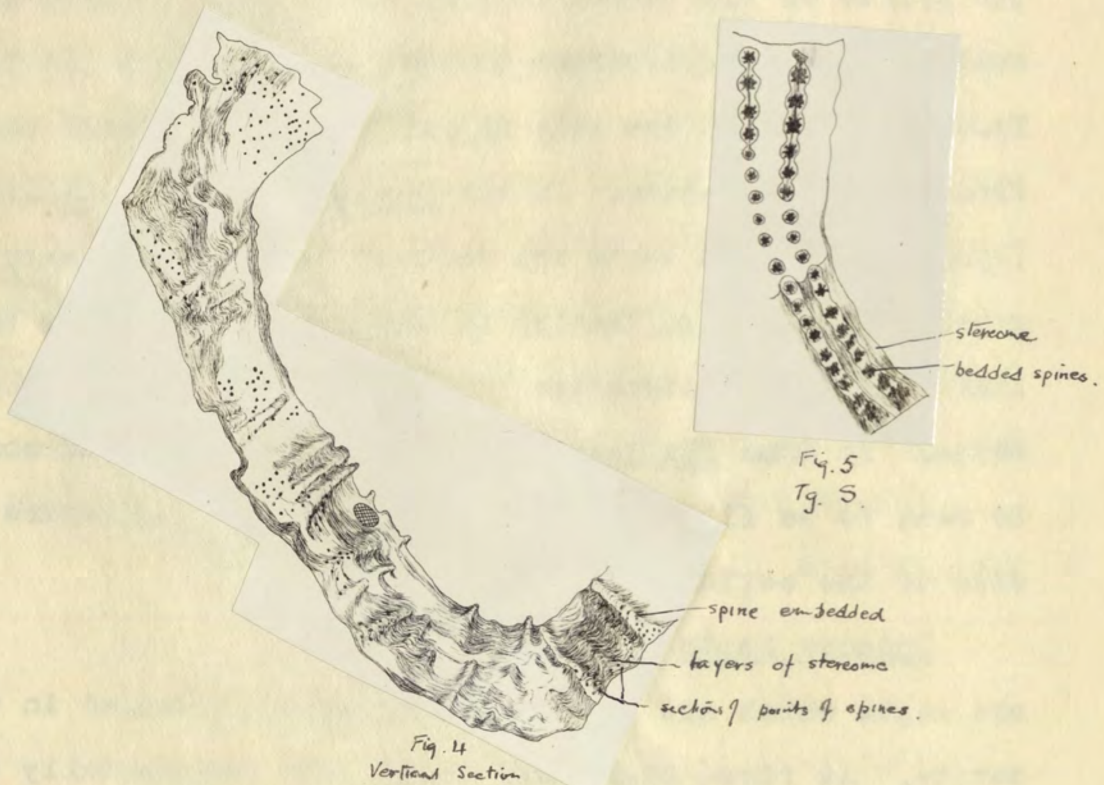


Fig. 4
Vertical Section

Fig. 5
Tg. S

Palaeocyclus porpita

Fig. 7 Fig. 6.

4, 5, 6, 7

spines; these lack a definite outline, and appear sporadic in their distribution, since they blend with the superimposed tissue. The lack of visible structure in spines and lining is probably due to fossilisation. That the lining tissue is superimposed is obvious from the fact that the spines are free in the calyx. Nevertheless it will be seen in other species with spinose septa that free spines are always associated with a lining stereome. This lining stereome seems to be of the nature and origin of horizontal tissue, being secreted by the base of the polyp, and not in invaginations in this base. The spines are directed at right angles to the layers of lining.

<u>Acanthocyclus.</u> See Figs. 4 and 5 in this paper, and Lang and Smith 1927, p.430, Fig.1. In two examples of <u>Acanthocyclus</u> sp. from the L. Ludlow shales of Ledbury Quarry, Malverns, each septum consists of one row of spines. All the spines are embedded in a thick lining to the wall, so that only their apices are free. The lining is of layered stereome, and the direction of the spines is always at right angles to the surface of the layers. The structure of the lining cannot be resolved by the microscope, but each spine consists of fibres radiating from a centre, the fibres being grouped so that a many pointed star is obtained in a T.S. of a spine, while Tg.S. of a spine shows a number of dots representing sections of these points. In median

vertical section the spine is seen to be pinnately fibrous. The spines are never so closely placed that the radiate arrangement of the fibres in T.S. is overcome. I regard it as more probable that each of these spines represents a simple trabecula than a compound one as in Cyclolites (See Ogilvie p.173, Fig.38c). The number of series of spines in Acanthocyclus is not incompatible with its diameter, as in Cantrillia.

Palaeocyclus.

The variations seen in the structure of the septa of this genus are very important. They connect up the spiniform septa seen in Acanthocyclus with the lammelar pinnately fibrous septa seen in Streptelasma. The only species studied by me is P. porpita (Linn.), from various horizons in the Wenlock. In it the spinose septa are free from one another in the upper half of the disc (See Fig.6); but are dilated and in contact in the lower half (See Fig.7). I have not yet seen slides suggesting that the lack of free space between the septa in the lower half is due to a lining to the wall of layered stereome as in Acanthocyclus. In the upper half of the disc the apices of the spines may be free, when they may be like many-pointed stars in cross section, or rounded. Or those of each septum are in contact to form a linear septum. Such a septum (See Fig.6) usually shows, by the local radiate arrangement of the fibres, the position of the spines; but one slide in the B.M. of a large individual from Gotland shows some septa in which all the radiate appearance is lost, and the septa are pinnately fibrous, and one cannot tell in T.S. the position of the spines. The structure of the septa of Palaeocyclus porpita, then, suggests that normal lamellar ~~septa~~ (pinnately or radiately fibrous) septa differ from spinose septa in the method of disposal of secondary thickening or stereome.

Tryplasma. In Tryplasma the septa typically consist of vertical rows of short spines whose bases are at the wall tissue. A many-layered secondary tissue (as described in Acanthocyclus) stretches from spine to spine, and in it the spines lose their individuality. Spines are seen also perpendicular to tabulae, which are invested with secondary tissue. Three specimens (in Sedg.Mus.Coll.) of Tryplasma loveni from Frojel Strand, Mulde Margelstein, show that in the same species, spinose septa and fibrous lamellar septa may occur. Two specimens show spines set in a stereome lining whose fibres are parallel to the base of the retreating polyp, and the third shows lamellar septa in contact. The lining has disappeared, and the spines have grown together except at their axial edges to form compact lamellar septa. The change is due to the laying down of the secondary deposit as fibres continuous with those of the septal spines, instead of as layers parallel to the base of the

Cystiphyllum sp.

Fig. 8.
Part of T.S.

Fig. 9
Part of V.S.

retreating polyp, and a septum like that illustrated in Fig.7 for Palaeocyclus results. There are suggestions in these individuals that this T.S. of the original spine was a many-pointed star as in Acanthocyclus, and some Palaeocyclus.

Cystiphyllum. See Figs. 8 and 9. See also Lang and Smith 1927 Pl.xxxvi. In this genus the septa are represented by spines which may arise on those dissepiments or tabulae where a deposition of stereome which is layered parallel to the base of the polyp occurs. If no such stereome is deposited, no spines occur. Also, the spines are always directed at right angles to the surface of the plate on which they are formed. Further the spines on the cysts are developed in radial planes as if those of each plane corresponded to one septum. But if each such series corresponds to one septum, there there is a phenomenally large number of septa in the corallite - 200 at a diameter of 1·5 cm.[1] Owing to fossilisation the structure of the spines and stereome is difficult to make out. No spines with a many-pointed star cross section as seen in Acanthocyclus and Palaeocyclus have been noticed. Wedekind (1927, p.64) states that the spines of one septal plane may join to form a complete septum. He does not describe the structure of the septum so formed, and I have not myself observed this. Lang and

(1) Since there seem to be too many series of spines to represent a normal number of septa, it may be that each spine is a homologue of one of the vertical rods of a Naos septum. See Pl.15.

Smith (1927, p.478) consider that the spines undoubtedly represent septa in an advanced stage of degeneration. I cannot see any evidence for such a view.

Calostylid Septa Figs. 10 and 11.

Dr S. Smith (1930)' has described these septa and summarised our knowledge of them. They are partly lamellar, but even then the lamellae are perforated by round pores, so that in T.S. this part of the septum appears to be discontinuous, and resembles a row of dots and dashes. Peripherally, and in the case of the major septa, axially as well, the pores have become numerous and the septa are represented by a meshwork of trabeculae. Although peripherally the septa may not altogether lose their individuality, the irregularly growing trabeculae unite them into a continuous spongy zone (See Fig.10).[1] These perforate septa are partly lamellar, and such parts, in the well preserved Gotland specimens of C. denticulata, can be seen to be formed of rod like elements which probably represent the simple trabeculae of Ogilvie, although the minute structure of each cannot be resolved by the microscope. These simple trabeculae stretch from the epitheca towards the axis of the coral, and are concave to the epitheca. They are the only exception to my knowledge to the rule that in the Rugosa, simple trabeculae or spines are arranged at right angles to the floor tissue, for the few plates seen cut across them not at right angles (See Fig.11)[1] S. Smith

1. See S. Smith 1930' Pl.10 fig 24, Pl.11 fig.7

Kodonophyllum truncatum.

Fig 12 Fig 12a

Septa in Transverse section from the same slide.

(Chonophyllum?) patellatum.

Fig. 13 T.S.

12. 12a 13

considers these septa to be degenerate, modified from the ordinary lamellar septum. In the young stages however, conditions are so masked by stereome that it cannot be seen whether the septa are lamellar or perforate; while it is not known what type of septa these perforate ones lead into in the Ludlow stage.

<u>Kodonophylloid Septa</u>

See Figs. 12, 12a. See also Smith and Tremberth 1929, Pl.8, Fig.6.

These are very important throughout the Wenlock. In my slides of <u>Kodonophyllum truncatum</u> they are dilated and in contact throughout the zone where dissepiments normally would be developed, the zone being very narrow in the apical part of the corallite, and very wide in the calical portion. While the dilated parts of the septa are usually pinnately fibrous in the slides I have examined, the fibres pointing peripherally where they meet at the median part of the septum (See Fig.12), in some parts the fibres are normal to the median plane; and in these cases the fibres next them on the peripheral side are pinnately arranged but with their points at the median plane directed axially (See Fig.12a). Such a structure is seen in <u>Palaeocyclus porpita</u> (See Fig.6) and Tryplasma. Whether each radiate group represents a compound trabecular or a simple one cannot be made out. In Tg.S. the septa are seen to be pinnately fibrous, the points of the fibres at the median plane pointing proximally. In vertical section (See Smith and Tremberth 1929 Pl.8, Fig.6) the fibres of the septum form sinuous lines which slope down peripherally. This I believe to give the direction of the primary trabeculae of the septum. I have not seen any T.S. in which the septa have the structure represented by Smith and Lang 1927, p.456, Fig.8, the septa of all my slides being resolvable ~~with~~ into fibres meeting usually pinnately, at the median plane.

(Chonophyllum ?) Patellatum from the Woolhope Limestone I understand to have exactly the same septal structure as Kodonophyllum truncatum. But in my slides continuity in the stereozone is obtained in two different ways. In the peripheral parts, the secondary deposit is fibrous continuous with the fibres of the septum; but in the axial parts, it invests the septa with a lining whose fibres are not continuous with those of the septa (See Fig.13). This is of interest in view of our discussion of the two ways of stereome deposition in Tryplasma and Palaeocyclus. Also, in the peripheral parts of the stereozone, the fibres are pinnately arranged in T.S. with their points at the median plane pointing axially; but this is inversion due to the everted calyx; and structurally these fibres are directed to the epitheca.

Xylodes pseudodianthus.

Fig. 14. T.S.

Spongophylloides grayi.

Fig. 15
T.S.

Fig. 16
Tg. S.

Acervularia ananas.

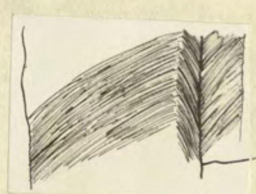


Fig. 17

14, 15, 16, 17

Carinate Septa.

These are seen in many genera and species in the Silurian. They are present sporadically on the septa of Petrozium dewari in the Valentian; but these septa are too thin for their structure to be resolved.

Xylodes pseu~~ca~~do dianthus shows well developed carinae. (See Fig.14). The typically thin septa of the ~~same~~ genus Xylodes have as yet given no sections showing whether they are pinnately fibrous or not. Some of the septa in parts of the coral may be carinate, or thickened. The carinae alternate on either side of the septum, and are never opposed to give the cross bar seen in Heliophyllum. They are described by Smith and Tremberth (1927, p.475, ~~Fig.15~~) as developed from elbows which arise from a zig-zagging of the septa. In vertical section, the sections of these carinae show that they grow upwards and inwards always at right angles to the surface of their own part of the calical floor. I have not yet thought of a method of formation of these carinae which fits all the facts. Something along the lines of Ogilvie's (pp.242, 243, and 247) explanation of septal granulations I consider most likely.

Spongophylloides grayi has dilated carinate septa which withdraw from the periphery in the adult stage, leaving a lonsdaleoid border of dissepiments. The septa themselves (in my slides) show a dark median part and a light outer stereome investment, and the structure of neither can be resolved. The septa are carinate in T.S. (see Fig.15); in Tg.S., this is seen to be due to their pronounced zig-zag course. (See Fig.16).

Ptilophyllum from the Ludlow of Gotland has carinate septa, the carinae not being developed on all septa; in V.S. the septa show trabeculae which are directed in from the epitheca at right angles to the dissepiments.

Acervularia. It is worthy of remark that in no septa yet described is there anything comparable to the area of divergence of the trabeculae seen in the hexacoral septum at the theca; i.e., where the costae and septa meet. But in Acervularia where there is always a distinct inner wall or aulos, there are traces of trabecular divergence at this wall (See Fig.17). A particularly good slide of A. ananas in the B.M., R. 3278, from the Wenlock of Stoke Edith, shows trabeculae with an area of divergence at the inner wall. A. ananas R. 28888 shows in T.S. that some at any rate of the septa are pinnately fibrous. Except just peripheral to the inner wall, the fibres are arranged with their points at the median plane of the septum directed peripherally; but for a short space first peripheral to the inner wall, they point the other way. Thus the inner wall of Acervularia has the same area of divergence of trabeculae as the theca of a hexacoral. But in Acervularia there is an additional set of fibres directed inwards and upwards from the epitheca. Whether all Acervularia are pinnately fibrous is uncertain. In some species some of the septa may be carinate.

Naos Septa.

This type of septa has been very fully dealt with in Part I of this thesis, and becomes a standard of reference for other modifications. Whether the radiately arranged rods are homologous with the trabecules of Acervularia etc., and the spines of Palaeocyclus and Tryplasma, or the more numerous species of Cystiphyllum and Cantrillia is an important unsolved problem.

Arachnophylloid Septa.

See Figs. 18 and 19.† See also Lang and Smith 1927, pp.452-3, Figs. 5-7; and Pl.xxxiv, Fig.3.

A curious modification of the septa can be seen in this genus, in both English and American members[1]. Peripheral to the inner ring of dissepiments, the septa fail entirely except at certain horizons in the corallite. when each septum breaks down into (or is replaced by) cellular tissue resting on the dissepiments, the cells being approximately cubes of 0·05 mm. a side. The tissue of one septum is continuous with that of its neighbours. In this tissue those walls which are nearly parallel to the direction of the original septum are the master walls, and are continuous, and thicker than the others. They alternate

(1) The Australian Arachnophyllum epistemoides Etheridge Jr. is probably not congeneric with these. The structure of its septa is more like that seen in the Bohemian Chonophyllids.

† Not finished.

in thickness near the inner ring of dissepiments, but peripherally after they have increased by interpolation, this alternation is lost. The remaining walls do not form linear series, being somewhat irregular in disposition. Lang and Smith 1927, p.466, state that each wall consists of a row of spines, which are connected by stereome, (This is not seen in my slides) perhaps because of inferior fossilisation. This most interesting modification requires a great deal of time to investigate properly.

Other Septa.

Rhys ~~Rapodes~~ and Stauria from the Ludlow of Scotland show ordinary pinnately fibrous septa.

In Ptycholopas turbinata var. verrucosa (= Omphyma subturbinatum (A. d'orb.) Ed. and Ill. 1851, p.401, the septa are very thin, and I have been unable to see whether they are pinnately fibrous or not. They are discontinuous both horizontally and vertically. Axially they do not always form continuous vertical lamellae, but may extend over the tabulae as a series of thin crests; peripherally, they either reach the epitheca, or abut against dissepiments as in Lonsdaleia.

In Plasmophyllum brevilamellatum (McCoy); as seen in T.S. of the holotype, the septa are dilated axially but modified peripherally somewhat like the Mesophylloid septa (See under Devonian).

DEVONIAN

Pycnactoid septa.

These are seen in the C.torquatum group which Wedekind (1924) has separated on the nature of these septa into the Ptenosphyllidae. The septa are dilated axially, the stereoms being fibrous and continuous with the fibres of the septa, and arranged almost at right angles to the median septal plane, where the points meet and are directed towards the epitheca.

Spinose septa.

These are seen in the Devonian Cystophyllids to be exactly similar to those of the Silurian Cystophyllids.

Naos septa.

These are seen in Poctas Bohemian Chenophylla, in Chonophyllum perfoliatum auctt and in Cyathophyllum tinocystis. I have not yet seen sufficient slides of this group to know what was the character of the septa before modification. Some of my slides however suggest that the arrangement was of Phillipsastraeoid cross bars, united by stereome (vide infra). If this turns out to be the typical structure, then we have the interesting condition that the Naos modification can arise in the Devonian barred septa as well as in the Carboniferous reinforced pinnate septa.

DEVONIAN SEPTA

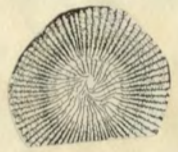


Fig 20

carinate septa

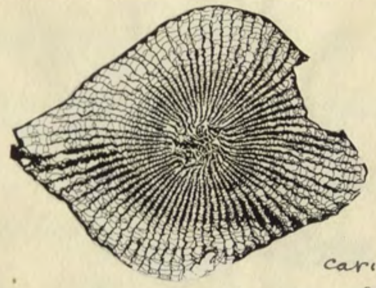


Fig 21

carinate septa.

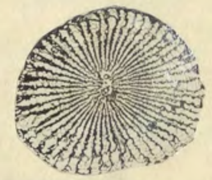
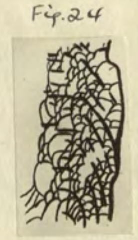


Fig. 22

Fig. 23

Unmodified & barred septa from same T.S.

Fig. 24



appearance of sections of carinae & bars in Vertical Section

Carinate Septa.

Carinate septa where the carinae on the two surfaces of the septum are not exactly opposed are well developed in C.cylindricum Schultz, C.helianthoides Goldfuss, - C.Spongiosum Frech. Stereome is variously aggregated about the carriae. I have no specimens and have been therefore unable to go into this carinate structure. Wedekind (1924 p.69) has grouped the corals showing this type of septa in his genera Keriophyllum Trematophyllum and Dohmophyllum (See Figs. 20, 21, and 22). I hope to prove that Wedekind's method of using the expression of a trend in septal structure in systematics is unsound.

Barred septa.

By this descriptive term is meant septa in which carinae normal to the side surfaces of the septa are exactly opposed on either side, so that in T.S. they give to the septa a barred appearance (See Fig. 23). In V.S. each cross bar or carina is a ridge on the side of the septum directed upwards and inwards, its curvature (see Fig. 24) being governed by the fact that it always remains at right angles to the surfaces of the dissepiments forming the floor tissue.

In Heliophyllum halli the bars are broadest and most distant. I have been unable to find whether they are modifications from the dilated septa of the early stage, or whether they arise independently. In the adult stage the bars are of the same degree of thickness as the septa, and in neither can the structure be resolved by a microscope. The bars and septa cross at right angles, which are not rounded off by stereome.

Phillips-astraea shows a cross bar septal structure analogous to and possibly homologous with that of Heliophyllum. The bars here however are very close together, and often do not project beyond the sides of the thick septa. They appear as denser bars in a lighter material, both darker and lighter forming the septa. Occasionally the right/left (and) components of these bars are not exactly opposed so that the alternate arrangement gives the ordinary carinate structure of the Devonian. Thus a relation between the carinate and barred septum is obtained. Frech (1885, 1 and 2) has noted that even in one individual, some of the septa may be barred, and others normal, without either bars or carinae. Thus the barred septa are similar to the Naos septa in occurrence. Not all the septa of not all the individuals of not all the species of this genus are modified. I have been unable to discover whether the non-carinate septa of Phillipsastraea are pinnately fibrous or not.

In Cosmophyllum Vollbrecht = Areophyllum Markov from the Eifelian, structures like the cross bars of Heliophyllum are seen piercing a dissepimental tissue, the normal radial parts of the septa being entirely absent. I have not examined any such corals, but have little doubt that these structures are homologous with the cross bars of Heliophyllum.

In a specimen, genus/species (and) unknown, from the Devonian, Parpiton (ign) Beach, (Sedg. Mus. Coll.) cross bars of the size and distance apart of Heliophyllum are seen being developed as modifications from very dilated septa, the bars being as broad as the width of these dilated septa. See Fig. 23. The axial ends and the dilated but unmodified septa are pinnately fibrous. On the formation of the bars, the rest of the stereome disappears, leaving an intervening radial part of a septum, or not.

Mesophylloid septa.

Probably the most interesting modification of all is seen in the septa of those corals which appear in collections labelled Mesophyllum; or Cyathophyllum damnionense. The correct nomenclature is uncertain. The specimen I used for my investigation was No. 10 in the Whidborne Collection, Sedg. Mus. The dilated septa of the axial area (I have been unable to resolve their minute structure under the microscope, become broken down peripherally, and dissepiment like plates which are very difficult to account for on the accepted understanding of the origin and formation of the septa. But my investigations on this structure are far from complete, and as I regard it as too important for the expression of premature conclusions, I propose not to enter further into the matter here. This type of modification is echoed in some Scottish Clisiophyllids . It is also seen in some septa of other Devonian corals; e.g. C.heterophyllum, and possibly also in the Silurian Plasmophyllum brevilamellatum.

Carboniferous.

In many of the Carboniferous corals, particularly the compound ones, the septa are so leaf thin that their structure is not resolvable. But three striking types stand out.

Naos septa.

These are seen in three Australian genera, as seen in Part I.

Mesophylloid septa.

Echoes of the Devonian Mesophylloid modifications are seen in some Scottish Clisiophyllids.

Caninoid septa.

The most striking feature of the septa of English Carboniferous corals is the dilation of the septa axial to the inner ring of dissepiments. It is seen in Clisiophyllum, Dibunophyllum, Cyathoclisia, Hettonia and Caninia. All the septa inside the inner ring of dissepiments may be dilated, or the dilation may be confined to those in the cardinal quadrants; or only those septa immediately neighbouring to the cardinal fossula are affected. The dilating stereome is laid down as an investment to the original septum; it may be continuous from one septum to the next along the surface of the innermost dissepiment. It is fibrous, the fibres lying, in T.S., at right angles to the median plane of the septum. It is light in colour and banded, with narrow dark lines running parallel to the surface of the septum and dissepiments (see Fig. 25).

CARBONIFEROUS SEPTA

Fig. 25.
T.S.

Tabulae

Fibres normal to dissepiments

Dissepiments

Fig. 26. Fibres normal to Tabulae.

PERMIAN SEPTA.

Fig. 27
appearance in T.S. of Fig. S.

Fig. 28
Caremo- D. australe.
T.S.

Fig. 29
T.S. of axial end of Septum

25, 26, 27, 28, 29.

In V.S. (Fig. 26) it shows the fibres directed at right angles to the curvature of the tabulae; and since these curve upwards and outwards, the trabecules of these dilated axial parts of the septa are directed at right angles to those of the undilating parts of the septa in the dissepimental area; the trabeculae of these are directed inwards and upwards, at right angles to the curvature of the dissepiments.

I have never noticed spinose septa, carinae or cross bars in Carboniferous septa.

Permian.

Permian Rugosa are remarkable for their dilated septa, which have clubbed axial ends, for their uniform lack of dissepimental tissue. Lonsdaleastraea and some massive forms Gerth has placed in Lonsdaleia are the only forms with dissepiments, and in one of them the dilated septa are modified; but specimens are not available and I cannot obtain a clear idea of the modification from the text and figures.

The dilation of Permian septa.

In slides of Timorphyllum wanneri and T.wanneri var. Varietatis in the B.M., in which the structure of the septa can be resolved by the microscope, fibres are arranged at right angles to the median plane of the septum, where there is a narrow band lighter or darker in colour. The fibrous investment shows narrow darker bands parallel to this median plane of the septum. This type of septum is seen in Fig. 27. In

Pterophyllum timorense (R.29471 Timor, B.M.) the median plane of the septum is occupied by a darker band which towards the axial end in T.S. becomes discontinuous in some of the septa, and the pieces are half moon shaped. A similar condition is sometimes seen in Lonsdeleia indica, and such septa tend to have clubbed axial ends. The significance of this is not yet understood, though E.Koker (1924) assumes that each half moon represents a compound trabecula.

In Carcinophyllum cristatum and Dibunophyllum tubetosum, the septa are pinnately fibrous in all the slides examined. But that the angle the fibres make to the median plane of the septum is not important in systematics is shown by the two species Carcinophyllum wichmanni and Dibunophyllum australe.

In Carcinophyllum wichmanni, R.29464, the septa have clubbed axial ends, with the dark half-moons not very regularly arranged discrete from the dark band in the median plane of the septum, as described above in Pterophyllum timorense; but the stereome is fibrous and arranged at right angles to the median plane as in T.wanneri; the banding parallel to the median plane is very pronounced. In R.29463, no structure can be seen by the microscope. In R.29449, however, the ~~far~~ fine septa are pinnately fibrous, the fibres directed at an acute angle to the epitheca at the median plane. Thus in this species there is evidence that the angle made by the fibres of the stereome at the median plane of the septum is not a specific character.

Similar results are obtained from Dibunophyllum (Verbeekiella) australe. In R.29459 the septa are pinnately fibrous, at an obtuse angle to the median plane. In R.29432 they are fibrous at right angles to the median plane, but a banding parallel to the septal plane is more conspicuous than the banding from fibres. The darker band of the median plane cannot be shown to break up axially, and the fibres are always at right angles to the surface of the axial edge. In D.(V.) australe R.29465, some of the septa show irregularity in the median dark line at the peripheral end, and the stereome on the top of the tabulae is fibrous like that of the septa. Two specimens R.29451 and R.29458 of D.australe show how the pinnately fibrous structure is connected with the perpendicular fibrous structure; for they show septa in which a pinnately fibrous median part is surrounded by banded stereome which is fibrous at right angles to the median plane, and the pinnately arranged fibres are continuous with the radially arranged. (See Fig. 28). The solution of this problem is probably to be found in a more detailed description of the way fibrous stereome may be deposited with its fibres in continuity with the fibres of the embryonic septa.

In Pterophyllum radiciforme Gerth, the only slide, R.29473 showed an unusual septal structure. The septa are club shaped, and of fibrous stereome, but they give the appearance of later more widely crescentic layers being added about earlier club shaped ones. The structure is illustrated in Fig. 28, but is not yet understood.

Enough has been said to show that the study of the Rugose septa bristles with difficulties, but is likely to yield important results. At present I consider that the spinose septum as seen in Acanthocyclus is the primitive type, and that all other types of septal structure can be explained in terms of trends.

BIBLIOGRAPHY TO PART III.

Etheridge.R.Jn.1909."Arachnophyllum from the Halysites limestone of the Mount Canobolas District".Rec: Geol.Surv:N.S.W.Vol.viii,pt4.pp304-307.plsxliv-xlvi.

Frech.F.1885[1]."Die Korallenfauna des Oberdevons in Deutschland",Zeit: der Deutsch:Geol:Gesell:1885 pp21-130, plsi-xi.

Frech.F.1885[2]."Nachtrage zur Korallenfauna des Oberdevons in Deutschland.Uber des Kalkgerust der Tetrakorallen". Zeits:der Deutsch: Geol:Gesell:1885 pp928-958 plxli.

Gerth.H.1921."DieKorallenfauna der Dyas von Timor".In J. Wanner,"Palaeontology von Timor".Lief.ix.abh.xvi,p pp67-147.pls cxlv-cl.

Koker.E.M.J.1924."Anthoza uit het Perm van het eiland Timor. 1 Zaphrentidae,Plerophyllidae,Cystiphyllidae, Amphiastraedae."In Brower 2 Nederl.Timor Exped.II. Jaarb.Mynw.Verh.1922.S1-50.IIpls, 26 text figs.

Lang.W.D. 1926,"Naos pagoda (Salter),the type of a New Genus of Silurian Corals".Q.J.G.S.vol,lxxxii,pp428-435,plxxx

Lang.W.D.& S.Smith.1927."ACCritical Revision of the Rugose Corals described by W.Lonsdale in Murchisons Silurian System."Q.J.G.S.Vol.lxxxiii pt 3 pp 448-491 pls xxxiv -xxxvii.

Ogilvie.MMM.1896."Microscopic & Systematic Study of Madreporian Types of Corals".Phil.Trans.Roy.Soc.B Vol.187,pp83-345.

Pocta.P.1902.In Barrande,"Système Silurien du centre de la Boheme.Premiere part:Recherches Paléontologiques, continuation editée par le Musée Bohême."Vol.iii,Tome ii Anthozoaires et Alcyonaires.QOPW(1902 (April 20) viii p 347.pls 20-118.

Ryder.T.A.1926 "PYCNACTIS*,MESACTIS and PHAULACTIS gen.nov. and DINOPHYLLUM,Linds."Ann.&Mag.Nat.Hist.Ser.9 Vol. xviii pp 385-401.pls ix-xii.

Smith.S.1930[1] "The Calostylidae,Roemer:A family of Rugose Corals with Perforate Septa".Ann.& mag.nat.Hist.Ser.10. Vol.v.pp 257-278.pls x-xii.

Smith.S.1930[2]. "Valentian Corals from Shropshire and Montgomeryshire,with a note on a New Stromatoporoid".Q.J.G.S. Vol.lxxxvi,p2,pp 291-330.pls xxvi-xxix.

Smith.S(& W.D.Lang.1927."On the Silurian Coral TRYPLASMA rugosum (Ed & H)Ann.Mag.Nat.Hist.Ser.9.Vol.xx,pp305-308 pl vi.

Smith.S.& R.Tremberth.1929."On the Silurian Corals Madreporites articulatus Wahlenberg,and Madrepora truncata Linneus." Ann.Mag.Nat.Hist.Ser.10,Vol.iii,pp 361-376.pls vii andviii

Wedekind R.1924."Das Mittledevon der Eifel".1 Teil."Die Tetrakorellen das Unteren Mittledevon."Schriff.der Sesells. zur de Bef.de gesamter.Naturwissenschaften zu Marburg. Bd.14 Heft.3 pp 93.

Wedekind.R.1927."Die Zoantharia Rugosa von Gotland.(Nordgotland.)" Sveriges.Geologiska Undersokuihg,Ser ,No 19; 95 pp.pls 30.


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PLATE I

Symplectophyllum mutatum nov; from the upper Viséan limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. ~~The~~ sections ~~figured below~~, and the specimens from ~~which they are cut, are~~ in the University of Queensland collection.

All figures magnified 2 diameters.

Fig.1:- Section, not perfectly transverse, from the holotype E 10. (upper surface of Fig.2).

Fig.2:- Vertical section from the same ~~ditto~~. This, with Fig.5 shows the diversity of axial structure to be found in one less stereoplasmid individual.

Figs.3:- and 4. Transverse sections from the same ~~ditto~~, showing very open axial structure. (upper surface of fig 4)

Fig.5:- Vertical section from the same ~~ditto~~. See Fig.2.

Figs.6:- and 7. Transverse sections from the same ~~ditto~~. (lower ~~upper~~ surface of (fig 4)
fig 6 transverse section from the same

Fig.8:- Transverse section from E 6, showing twisted axial lamellae. (upper surface of fig 8

Fig.9:- Vertical section from the same ~~ditto~~, showing highly arched tabulae, compare with the lower part of Fig.2; showing also rods reminiscent of the 'vertical pillars' of Naos Lang. upper

Fig.10:- Transverse section from early stage of ditto, showing stereoplasmid nature. lower surface of fig 8.

PLATE I

PLATE 2

Symplectophyllum mutatum nov. from the Upper Viséan limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. ~~The~~ Sections ~~figured below~~, and ~~the~~ specimens ~~from which they are cut, are~~ in the University of Queensland collection.

All figures magnified 2 diameters.

Fig.1:- Transverse section from F. 2385 (upper surface of Fig.2). The appearance of a fossula is due to malformation. For sections along lines AB, CD, ~~EF,~~ see Pl.5, Figs.5,6, & 7.

Fig.2:- Vertical section from ditto.

Fig.3:- Transverse section from F 2454; showing very open axial structure. For inset see Pl.5 Fig.1.

Fig.4:- Vertical section from ditto; showing complete, slightly domed tabulae. For enlargement of inset see Pl.5, Fig.9.

Fig.5:- Transverse section from E 1, showing the structure of the septa and a non-stereoplasmid twisted axial structure. ~~For enlargement of inset, see Pl.5, Fig.1.~~

Fig.6:- Transverse section from E.N. with loose axial structure.

Fig.7:- Transverse section from F 2451, with axial structure reminiscent of Dibunophyllum, Thomson and Nicholson.

Fig.8:- Transverse section from early stage of E 4, showing median axial lamella.

Figs.9, 10, 11 & 12:- Serial transverse sections from E.4.

PLATE 2

PLATE 3

Symplectophyllum mutatum nov; from the Upper Viséan limestones of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collection.

All figures magnified 2 diameters.

Stereoplasmid individuals.

Fig.1:- Transverse section from F 2512; a stereoplasmid individual showing septal structures.

Fig.2:- Transverse section from F 2511. For section along line AB, see Pl.5, Fig.4.

Fig.3:- Vertical section from ditto, showing variability of stereoplasm in the axial structure.

Fig.4:- Transverse section from young stage of ditto, with open stereoplasmid axial structure.

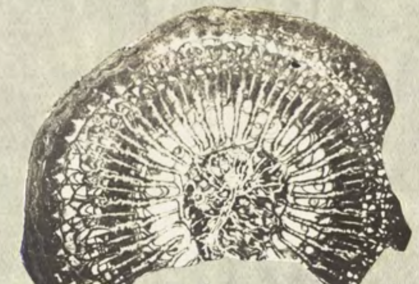
Fig.5:- Vertical section from F 2499.

Fig.6:- Diagonal section from F 2489, showing twisted stereoplasmid axial structure.

Fig.7:- Young stage of E 8, a stereoplasmid individual.

Fig.8:- Transverse section of F 2514.

PLATE 3



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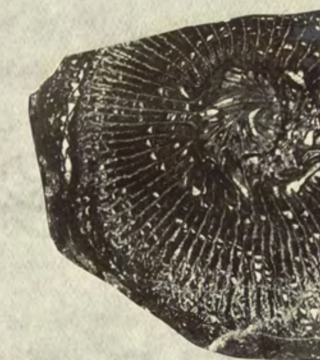

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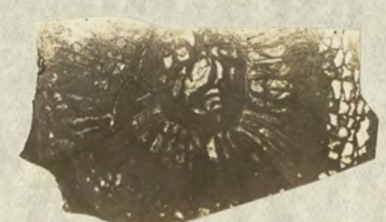

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PLATE 4

Illustrating the cavernous structure of the median parts of the septa of Symplectophyllum mutatum nov.; from the Upper Viséan limestones of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collection.

Figs. 1, 2 & 3 x 10 diameters.

Figs. 4, 5 & 6 x 2 diameters.

Fig.1:- An enlargement of inset in Fig.4, showing details of septal structure in transverse section.

Fig.2:- An enlargement of inset in Fig.5, showing details of cavernous septal structure in transverse section.

Fig.3:- An enlargement of inset in Fig.6, showing details of cavernous septal structure in vertical tangential section.

Fig.4:- Transverse section from F 2512. See Fig.1.

Fig.5:- Transverse section from F 2489. See Figs.2 & 3. and Pl.5,Fig.3.

Fig.6:- Tangential section through line AB in Fig.5. See Fig.3.

PLATE 4

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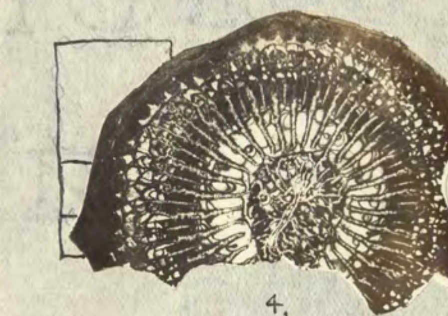

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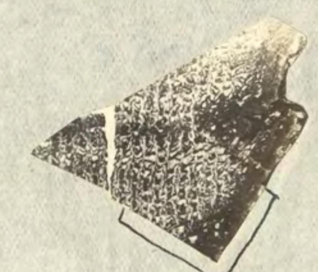

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PLATE 5 (Compare Plates 14-16)

Illustrating the peripheral modifications into horizontal tissue of Symplectophyllum mutatum nov.; from the Upper Viséan limestone of Latza's Farm in Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collections.

Fig.1:- Horizontal tissue replacing the peripheral parts of the septa seen in transverse section. Enlarged from inset in Pl.2, Fig.3 x 20 diameters.

Fig.2:- Ditto seen in peripheral tangential section. Enlarged from inset of Fig.3. x 10 diameters.

Fig.3:- Peripheral tangential section through the peripheral modifications of the septa in F 2489; (through line CD in Pl.4, Fig.5) x 2.

Fig.4:- Ditto through ditto in F 2511 (through line AB in Pl.3, Fig.2). x 2.

Fig.5:- Ditto through ditto in F 2385 along line AB in Pl.2, Fig1. x 2.

Fig.6:- Tangential section through ditto in ditto along line CD in ditto. x 2.

Fig.7:- Ditto through ditto in ditto along line EF in ditto. x 2.

Fig.8:- Inset in Fig.7 enlarged. x 10.

Fig.9:- Vertical section of F 2545, showing the peripheral modification of the septa in vertical sections, and structures (A) similar to the vertical pillars of Naos Lang. An enlargement of inset of Pl.2, Fig.4. x 10.

PLATE 5


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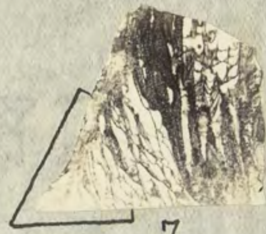
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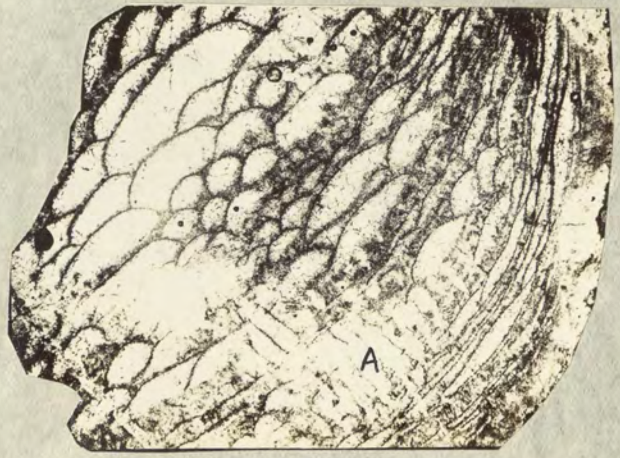

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PLATE 6

Amygdalophyllum Dun and Benson.

All figures x 2 diameters.

Fig.1:- A. etheridgei Dun and Benson. Reproduction of a transverse section figured by Benson and Smith 1923, Pl.viii, Fig.1. Burindi Series, Babbinboon, N.S.W.

Fig.2:- A. etheridgei Dun and Benson. Reproduction of a vertical section, figured by Benson and Smith 1923, Pl.viii, Fig.1. Burindi Series, Babbinboon, N.S.W.

Fig.3:- A. inopinatum (Etheridge) Transverse section of E. 24 in the University of Queensland Collection from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland; showing septal detail in younger adult stage.

Fig.4:- Vertical section of ditto. (Fig.3 is from lower surface, and Fig.5 from upper surface).

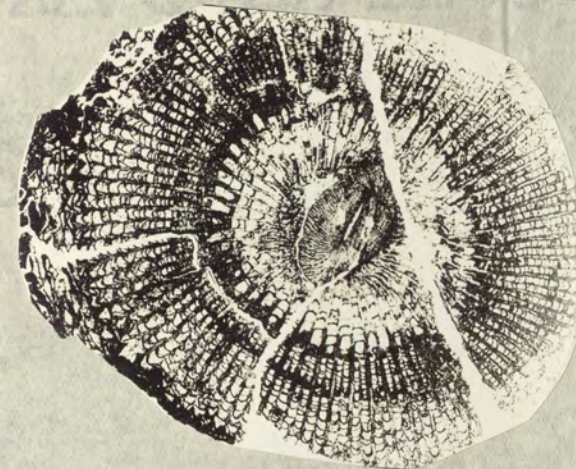
Fig.5:- Transverse section of ditto.

Fig.6:- A. inopinatum (Etheridge) Transverse section of F 2304 in the same collection from the same horizon and locality.

Fig.7:- A. inopinatum (Etheridge) Transverse section of F 2546 in the same collection from the same horizon and locality.

Fig.8:- Vertical section of ditto showing basal outgrowth for attachment.

PLATE 6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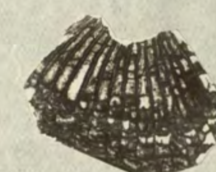
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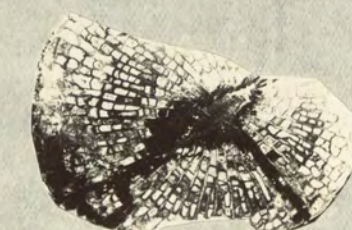
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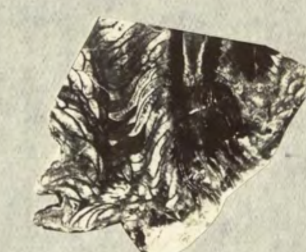
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PLATE 7

Amygdalophyllum Dun and Benson.

All the sections figured below and the sections from which they are cut, are in the University of Queensland Collection, from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

All figures magnified 2 diameters.

Fig.1:- A. inopinatum Etheridge. Transverse section from F 2493.

Fig.2:- A. inopinatum Etheridge. Transverse section from F 2491, showing peripheral Naos modifications of the septa.

Fig.3:- Vertical section of ditto.

Fig.4:- A. Vallum nov. Transverse section from the holotype, E 30.

Fig.5:- Vertical section from ditto.

Fig.6:- Transverse section from ditto, younger stage.

Fig.7:- A. vallum nov. Transverse sections from F 2453.

PLATE 7

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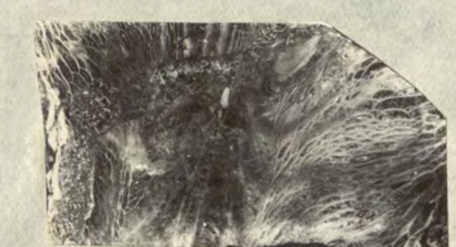

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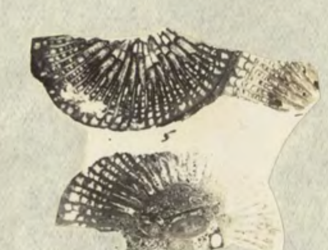

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PLATE 8

Amygdalophyllum conicum nov., from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland; the sections figured below and the specimens from which they are cut are in the University of Queensland collection, Brisbane.

All figures magnified 2 diameters.

Fig.1:- A. conicum nov., external appearance.

Figs.2-9. :- A.conicum nov., Serial transverse sections of the holotype E 36.

Figs.10-19:- A. conicum nov. Serial transverse sections of syntype F 2437 showing discontinuous septa.

PLATE 8

PLATE 9

Amygdalophyllum conicum nov., from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections figured below and the specimens from which they are cut are in the University of Queensland Collection, Brisbane.

All figures magnified 2 diameters.

Fig.1:- Vertical section from F 2498.

Fig.2:- Transverse section from ditto, showing discontinuous septa.

Fig.3:- Vertical section from F 2436.

Fig.4:- Transverse section from ditto, being upper surface of Fig.3.

Figs.5-8: Serial transverse sections from syntype F 2445 showing the septa with peripheral zone of thickening.

Figs.9-16 :- Serial transverse sections from syntype F(c) showing the septa modified peripherally.

PLATE 9

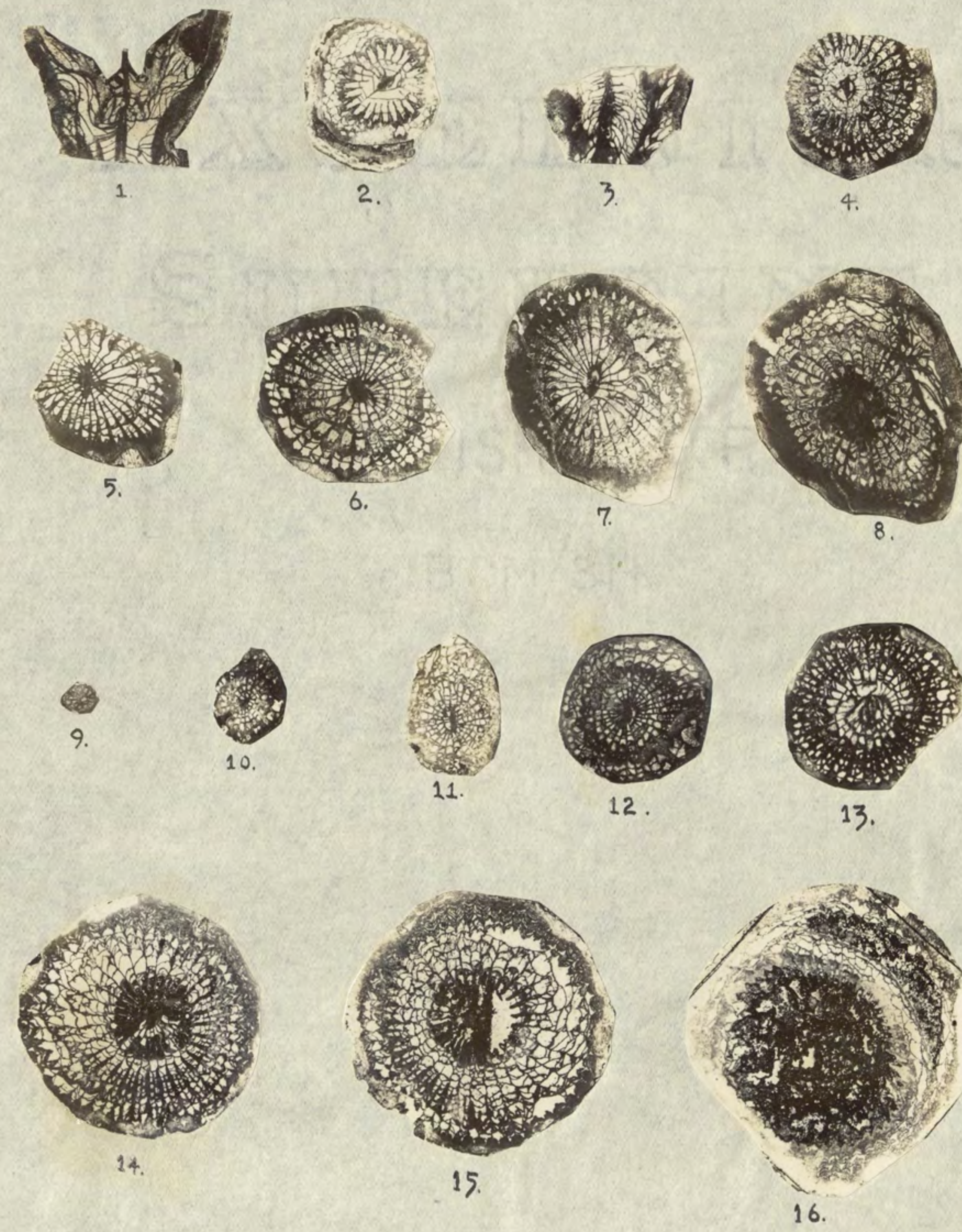


PLATE 10

Amygdalophyllum sp. near conicum from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. Specimen F 2449, in the University of Queensland Collection, Brisbane.

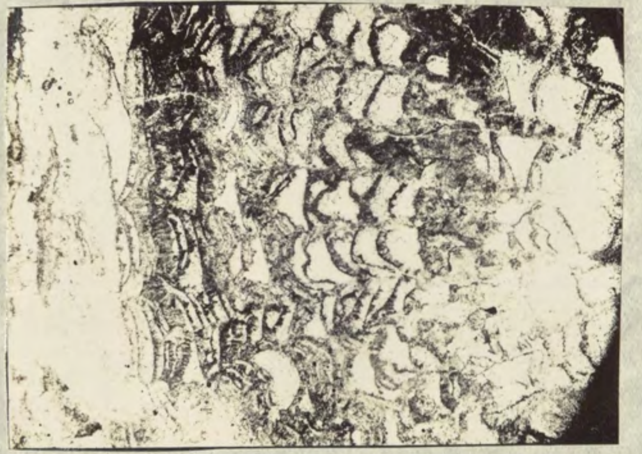
Fig.1:- Transverse section showing peripheral modification of septa x 10. An enlargement of inset in Fig.2.

Fig.2:- Transverse section. x 2.

Fig.3:- Vertical section showing peripheral modification of septa with stereome granules arranged in rods x 10. An enlargement of inset in Fig.4.

Fig.4:- Vertical section x 2.

PLATE 10



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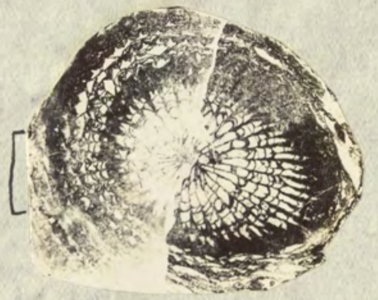

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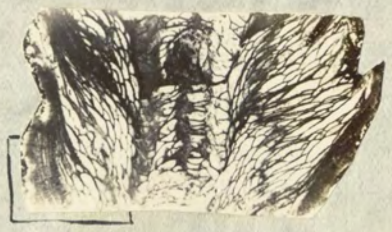

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PLATE 11

Aphrophyllum Smith

Fig.1:- A.hallense Smith Polished surface. Nat. size. Brit. Mus. R 29634. Quarry near Taree, N.S.W. in the Viséan Burindi Series.

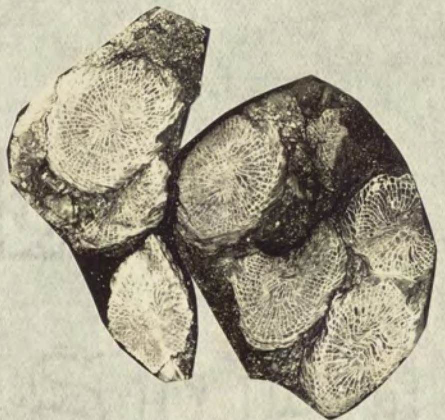
Fig.2:- A.hallense Smith. Transverse section; Bingara, N.S.W. Age Viséan (Burindi Series) University of Queensland Collection x 2.

Fig.3:- A.hallense Smith. Vertical section ditto x 2.

Fig.4:- Aphrophyllum foliaceum nov. Holotype, specimen F 2430 in the University of Queensland Collection, from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. x $\frac{1}{2}$.

Fig.5:- A. foliaceum nov.; Transverse section of paratype, E 22 in the same collection x 2.

PLATE 11



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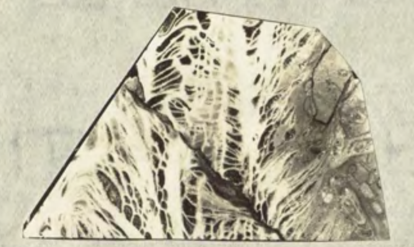

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PLATE 12

Aphrophyllum foliaceum nov. from the Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland. All sections figured below and the specimens from which they are cut are in the University of Queensland Collection, Brisbane.

All figures x 2 diameters

Fig.1:- Diagonal section (upper surface of Fig.2) of E L.31., shows septa with Naos like modification.

Fig.2:- Vertical section of ditto.

Fig.3:- Transverse section (lower surface of Fig.2) of ditto.

Fig.4:- Transverse section of F 2536.

PLATE 12

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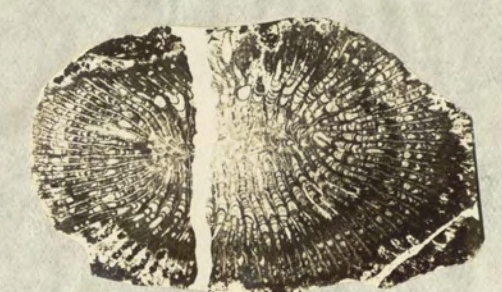

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PLATE 13

Aphrophyllum foliaceum nov., from the Upper Viséan Limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. All sections figured below and the specimens from which they are cut are in the University of Queensland Collection, Brisbane.

All figures x 2 diameters.

Fig.1:- Transverse section, E 20, shows the peripheral zone of dissepiments partly preserved.

Fig.2:- Transverse section F 2502.

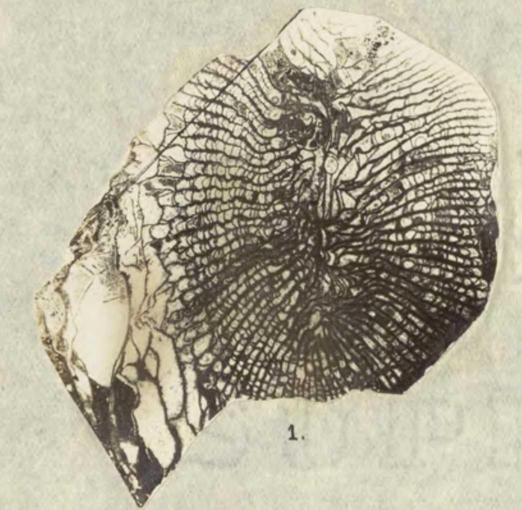
Fig.3:- Ditto, at a younger stage.

Fig.4:- Transverse section of E 21 (lower surface of Fig.5).

Fig.5:- Vertical section ditto.

Fig.6:- Transverse section of E 23. Young stage.

PLATE 13



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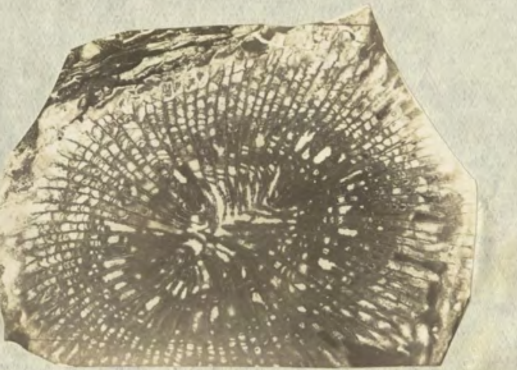

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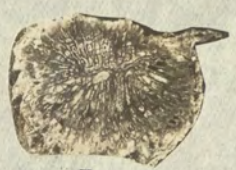

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PLATE 14

Compare Plates 5, 9 & 10.

Fig.1:- Part of transverse section of "Chonophyllum perfoliatum" auctt. No.168 Sedgwick Museum, Cambridge; from the Middle Devonian of Ramsleigh qy., S. Devon. showing the modified septa x 2.

Fig.2:- Tangential section of ditto. x 2.

Fig.3:- Longitudinal section of ditto. x 2.

Fig.4:- Transverse section of Maos pagoda Lang from the Niagara Formation (= Wenlock) of Melville I., Arctic America, R 25163 in the British Museum (reproduced from Lang 1926, Pl.xxx, Fig.1). x 2.

Fig.5:- Radial section of the same specimen, reproduced from Lang 1926, Pl.xxx, Fig.2. "The section is not truly radial; but on the left it lies mainly in the plane of a dissepimental alley, and on the right mainly in the plane of a septum. The globular structures are dissepiments; the saucer like horizontal structures and the pillar-like vertical structures are septal tissue." x 2.

Fig.6:- Tangential section of the same specimen, reproduced from Lang 1926, Pl.xxx, Fig.3.

PLATE 14

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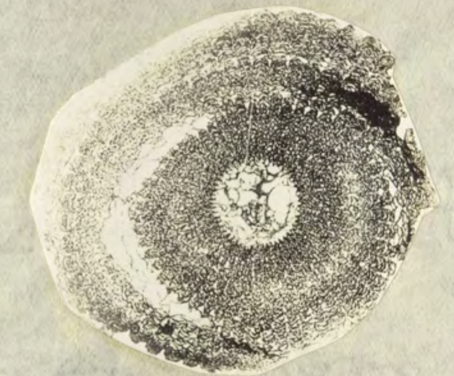

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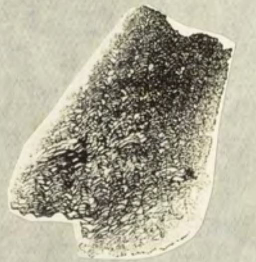

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PLATE 15

Skeletal Malformation in ? A. ionopinatum (Etheridge fils) from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

The slides figured below and the specimens from which they are cut are in the University of Queensland collection.

Fig.1:- Transverse section of F 2460; upper surface of Fig.2. x 2.

Fig.2:- Longitudinal section of ditto. x 2.

Fig.3:- Transverse section of ditto; lower surface of Fig.2. x 2.

Fig.4:- Longitudinal section of ditto showing structure of stereome. x 2.

PLATE 15

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3.

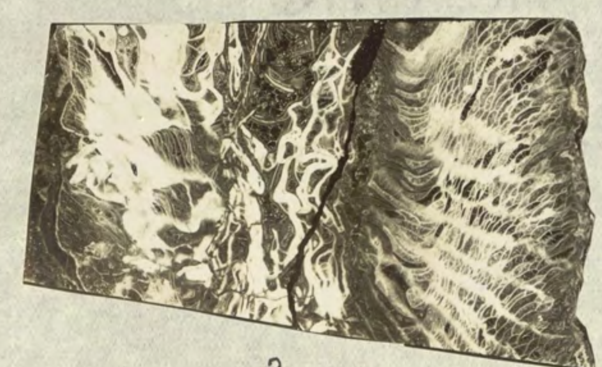

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PLATE 16

Carcinophyllum patellum nov. from the Upper Viséen limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland; the sections figured below and the specimens from which they are cut are in the University of Queensland collection.

All figures (except Fig.1) x 2 diameters.

Fig.1:- External view of holotype.(Nat.size), F 2834.

Fig.2:- Transverse section of ditto.

Fig.3:- Transverse section of F 2836

Fig.4:- Vertical section of ditto.

Fig.5:- Transverse section of F 2432.

Fig.6:- Transverse section of F 2505, a very stereoplasmid individual.

Fig.7:- Vertical section of ditto.

Figs.8-14:- Sections (in series) of E 11.

Figs.15-18:- Sections (in series) of F 2460, a less stereoplasmid individual.

Figs.19-22 :- Sections of E 12.

PLATE 16

PLATE 17

Lithostrotion columnare Etheridge

The sections figured below and the specimens from which they are cut are in the University of Queensland collection.

All figures (except Fig.1) x 2 diameters.

Fig.1:- Topotype (from Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland) F Natural size

Fig.2:- Vertical section showing typical incomplete tabulae. Topotype; L. 31. 6.

Fig.3:- Vertical section showing tabulae in two series. Topotype; F 2538.

Fig.4:- Vertical section showing typical incomplete tabulae. Slide F 6541 from specimen A.M. 186 in Australian Museum from the Viséan Limestone of Horton R., between Eulowrie and Pal Lal, N.S.W.

Fig.5:- Transverse section showing typical aspect. Topotype L.31. 8.

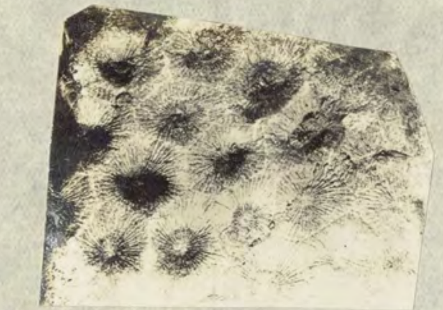
Fig.6:- Transverse section showing septa with-drawing from periphery. A.M. 331 or 186, Horton R. Between Eulowrie and Pal Lal. F 6543 in Australian Museum.

Fig.7:- Transverse section showing disappearance of epitheca. Topotype L.31. 6.

Fig.8:- Transverse section, F 2513 typical of the species occurring in Upper Visean limestone at Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland.

Fig.9:- Vertical section, ditto, showing the two series of tabulae.

PLATE 17



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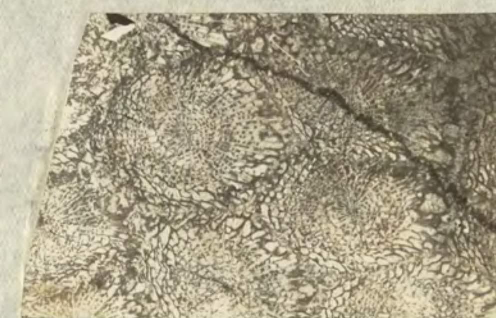

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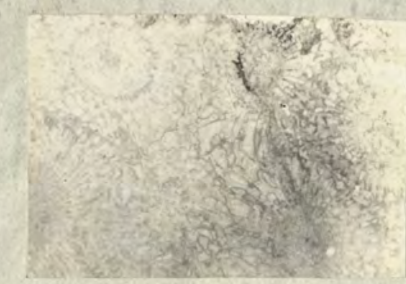

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PLATE 18

Lithostrotion stanvellense Etheridge

The sections and specimens referred to below are in the University of Queensland collection.

All figures (except Fig.1) x 2 diameters.

Fig.1:- External appearance x 1, from Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland (Upper Viséan) F x

Fig.2:- Transverse section same locality as Fig.1; showing septa confluent with columella. Typical.

Fig.3:- Transverse section showing septa withdrawn from columella, same locality. F 2392.

Fig.4:- Vertical section showing complete tabulae (from large phaceloid corallum F 2383) same locality.

Fig.5:- Vertical section showing incomplete tabulae (from typical dendroid corallum) F x, same locality.

Fig.6:- Transverse section of large corallum budding calicularly, and with septa much withdrawn from columella, from Riverleigh.

Fig.7:- Transverse section, Bingara, N.S.W., showing stereome B 2.

Fig.8:- Vertical section ditto.

Fig.9:- Transverse section showing bud and parent with common epitheca, Riverleigh F 24.

PLATE 18

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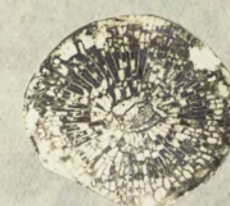

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PLATE 19

Lithostrotion arundineum Etheridge

All figures (except Fig.1) x 2 diameters.

Fig.1:- External appearance of paratype (from the Upper Viséan limestone of Lion Ck., Stanwell, near Rockhampton, Queensland). Natural size. Reproduced from Etheridge, 1900, Pl.1, Fig. 3 Specimen in Geological Survey of Queensland Collection.

Fig.2:- Transverse section of topotype; showing septa confluent with columella; and also septa withdrawn from contact with columella. In the University of Queensland collection.

Fig.3:- Vertical section of topotype; showing the arrangement of the tabulae in two series. In the University of Queensland collection.

Fig.4:- Transverse section F 6544 of Australian Museum specimen A.M. 565; from the Horton River between Eulowrie and Pal Lal, N.S.W., showing approach to Cionodendron Benson and Smith in number of septa and size of columella.

Fig.5:- Vertical section F 6544 of ditto; showing typical L. arundineum tabulae.

Fig.6:- Transverse section of typical L. arundineum from near Eulowrie, section F 6546 from spec. A.M. 184 in Australian Museum collection.

Fig.7:- Transverse section of F 2537 (University of Queensland Collection) from Mt. Grim, near Gladstone, Queensland.

Fig.8:- Vertical section of ditto.

Fig.9:- Transverse section of Cionodendron columen Benson and Smith, for comparison with L. arundineum Etheridge. Slide in possession of Dr Stanley Smith, the University of Bristol, from the holotype. (See page 79).

Fig.10:- Vertical section of ditto.

PLATE 19

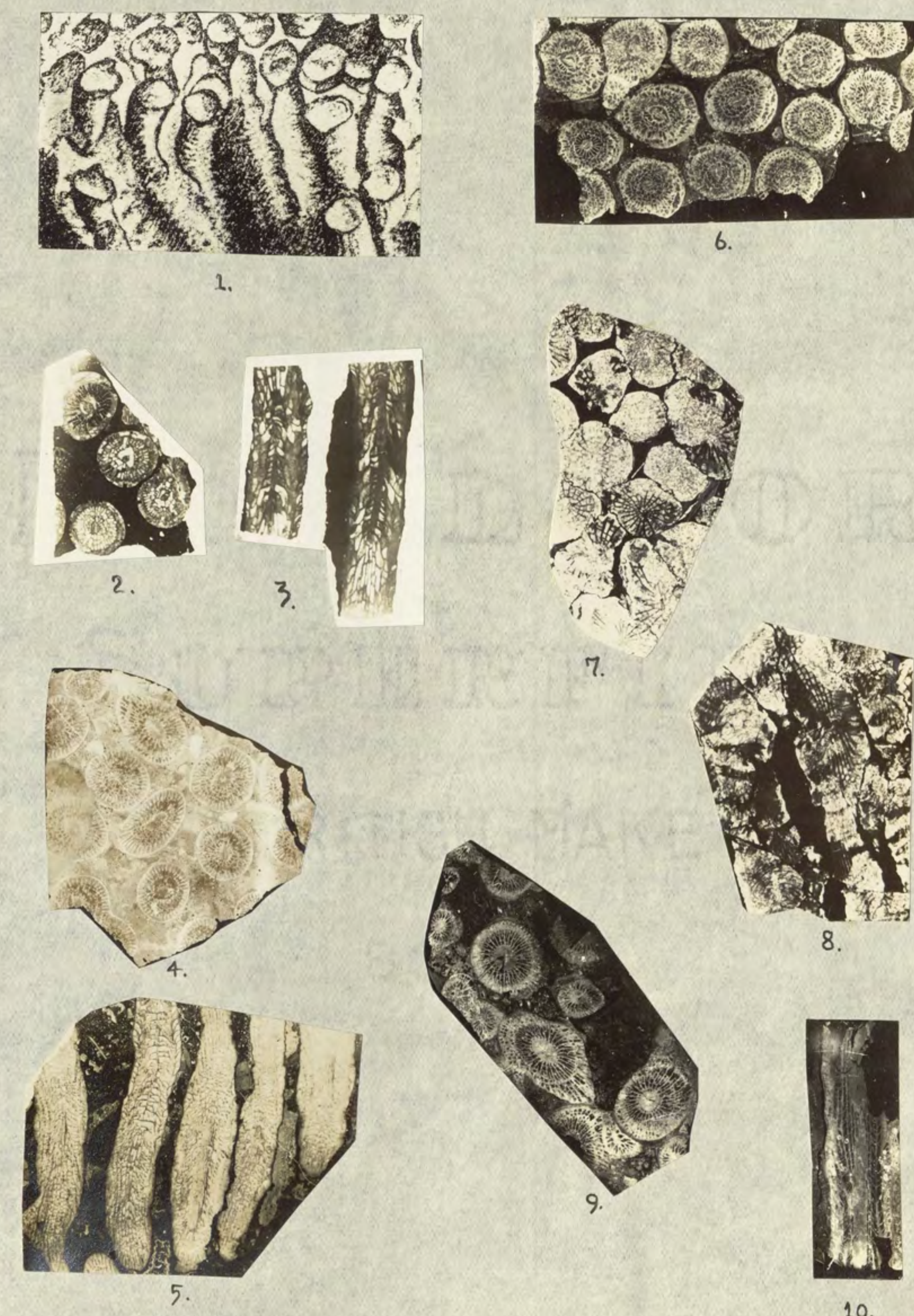

PLATE 20

Fig. 1:- Lithostrotion sp. {Diphyphyllum sp.}. Transverse section of specimen 4510 (or 4515 ?) in the Geological Survey of New South Wales Collection, from the Viséan (Burindi) limestone of the Parish of Moorawarra, near Somerton, New South Wales in the possession of Dr Stanley Smith, the University of Bristol x 2.

Fig. 2:- Vertical section of ditto, ~~British Museum section B~~. x 2.

Fig. 3:- External aspect of holotype of Lithostrotion sp. {Diphystrotion mutabile nov.} from the Upper Visean limestone of Lion Ck, Stanwell, near Rockhampton, Queensland.

Fig. 4:- F 2387 in the University of Queensland Collection. x 4. (In transverse section).

Fig. 5:- Ditto x 2

Fig. 6:- Drawings of some corallites from ditto x

Fig. 7:- Vertical section of ditto. x 2.

PLATE 20


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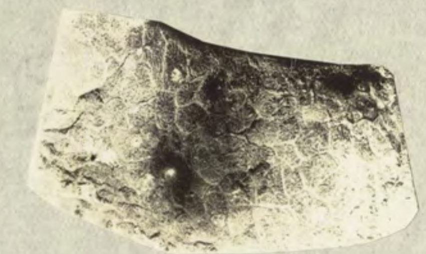
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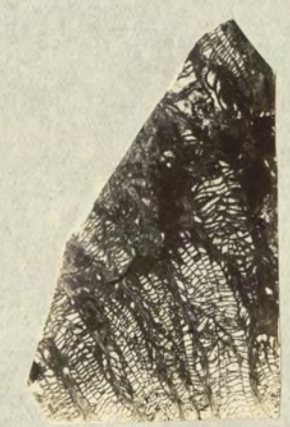
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PLATE 21

Orionastraea lonsdaleoides nov. from the Upper Viséan Limestone of Latzas Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections and specimens referred to below are in the University of Queensland Collection.

All figures (except Fig. 1) x 2 diameters.

Fig. 1:- External aspect of paratype F.2529 showing characteristic weathered appearance. Natural size.

Fig. 2:- Transverse section of holotype. F p.

Fig. 3:- Ditto, showing small bud.

Fig. 4:- Vertical section of ditto.

Fig. 5:- Vertical section of F.2533.

Fig. 6:- Transverse section of ditto.

Fig. 7:- Transverse section of F.2524.

Fig. 8:- Vertical section of ditto.

PLATE 21

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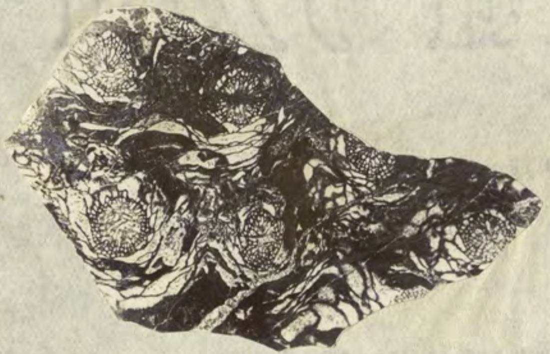

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PLATE 22

<u>Aulina simplex</u> nov. from the Upper Viséan limestone of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections and specimens referred to below are in the University of Queensland Collection.

Figs. 1-17:- Serial sections of the holotype, B. (Figs. 1-6 x 2, Figs. 7-17 x 4).

Fig. 18:- Vertical section of F 2420. x 2.

Fig. 19:- Paratype. Natural size.

PLATE 22

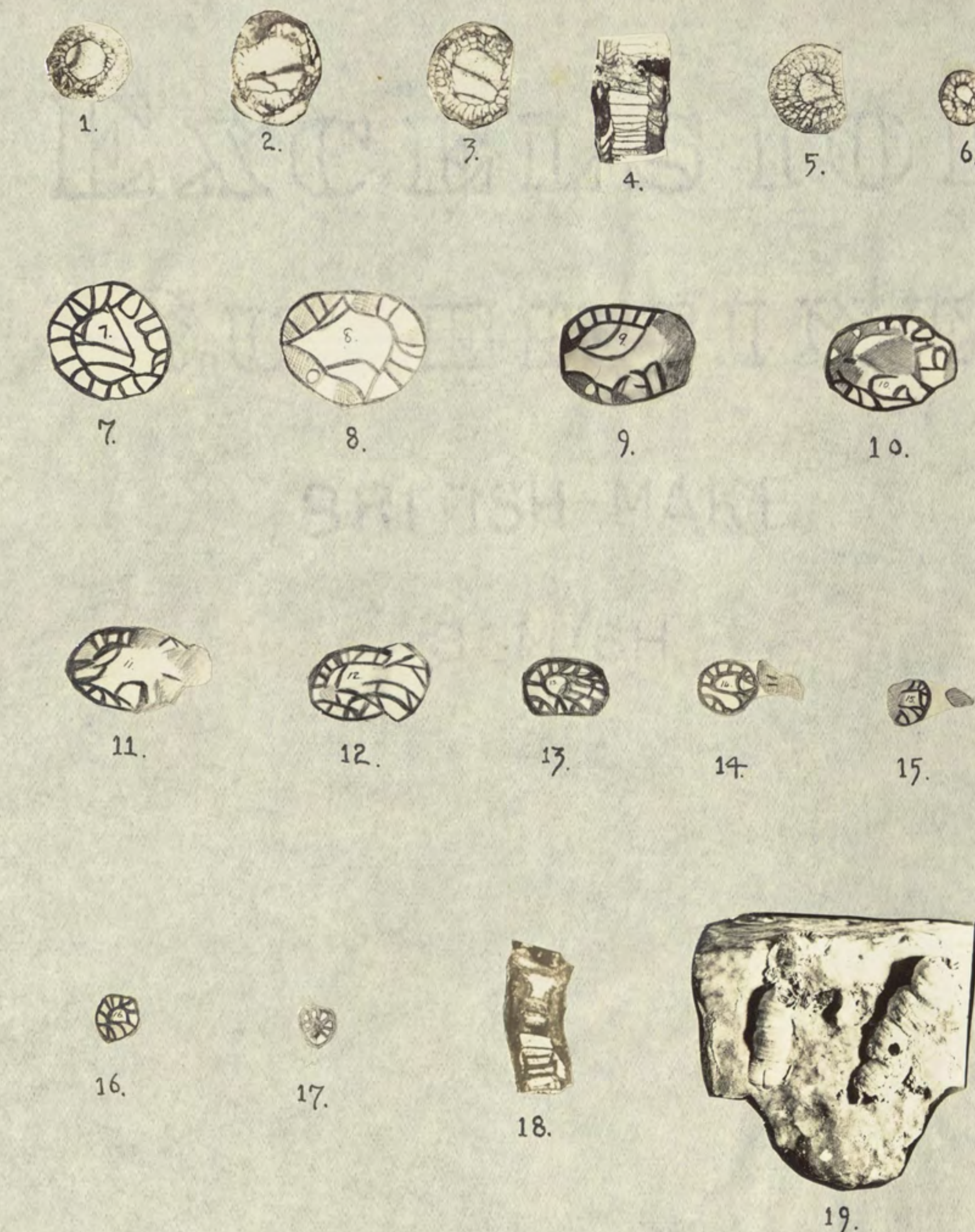

PLATE 23

Michelinia dendroides nov. from the Upper Visean Limestones of Latza's Farm, Portion 22, Parish of Riverleigh, near Mundubbera, Queensland. The sections and specimens referred to below are in the University of Queensland collection.

All figures, (except Fig.1) x 2 diameters.

Fig.1:- Holotype, F natural size.

Fig.2:- View of calices on stunted branch.

Fig.3:- Transverse section of E.52

Fig.4:- Ditto.

Fig.5:- Vertical section of E.9. 53

Fig.6:- Ditto.

Fig.7:- Transverse section of E.50.

Fig.8:- Ditto.

Fig.9:- Tangential section of E.51.

Fig.10:- Vertical section of E.51. Note septal spines.

Fig.11:- Michelinia sp Etheridge 1900 p.7 from the Upper Visean limestone of Lime Ck. Stanwell, near Rockhampton, Queensland. F.

PLATE 23

PLATE 24

Syringopora syrinx Etheridge Palaeacis sp.

Fig.1:- S.syrinx Etheridge in his collection of the Geological Survey of Queensland, from two crystalline limestone Crinoid Mt., Digium, Barmundoo Goldfield, near Gladstone, Q. Natural size, showing external aspect.

Fig.2:- S.syrinx Etheridge. Transverse section of L. in the University of Queensland collection from the Upper Visean limestone of Lime Ck., Stanwell, near Rockhampton, Q. x 2

Fig.3:- S.syrinx Etheridge. Vertical section of Ditto. x 2

Fig.4:- S.syrinx Etheridge. Vertical section of F. in the University of Queensland collection from the Upper Visean limestone of Latza's farm, Portion 22, Parish of Riverleigh, near Mundubhera, Queensland x 2.

Fig.5:- Palaeacis sp.cf.cuneiformis Haime. External View. From the Upper Visean Limestone of Riverleigh, near Mundubbera, Queensland. x 2.

Fig.6:- Ditto. Abnormally shaped specimen x 1.

PLATE 24


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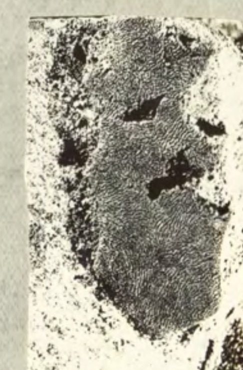
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